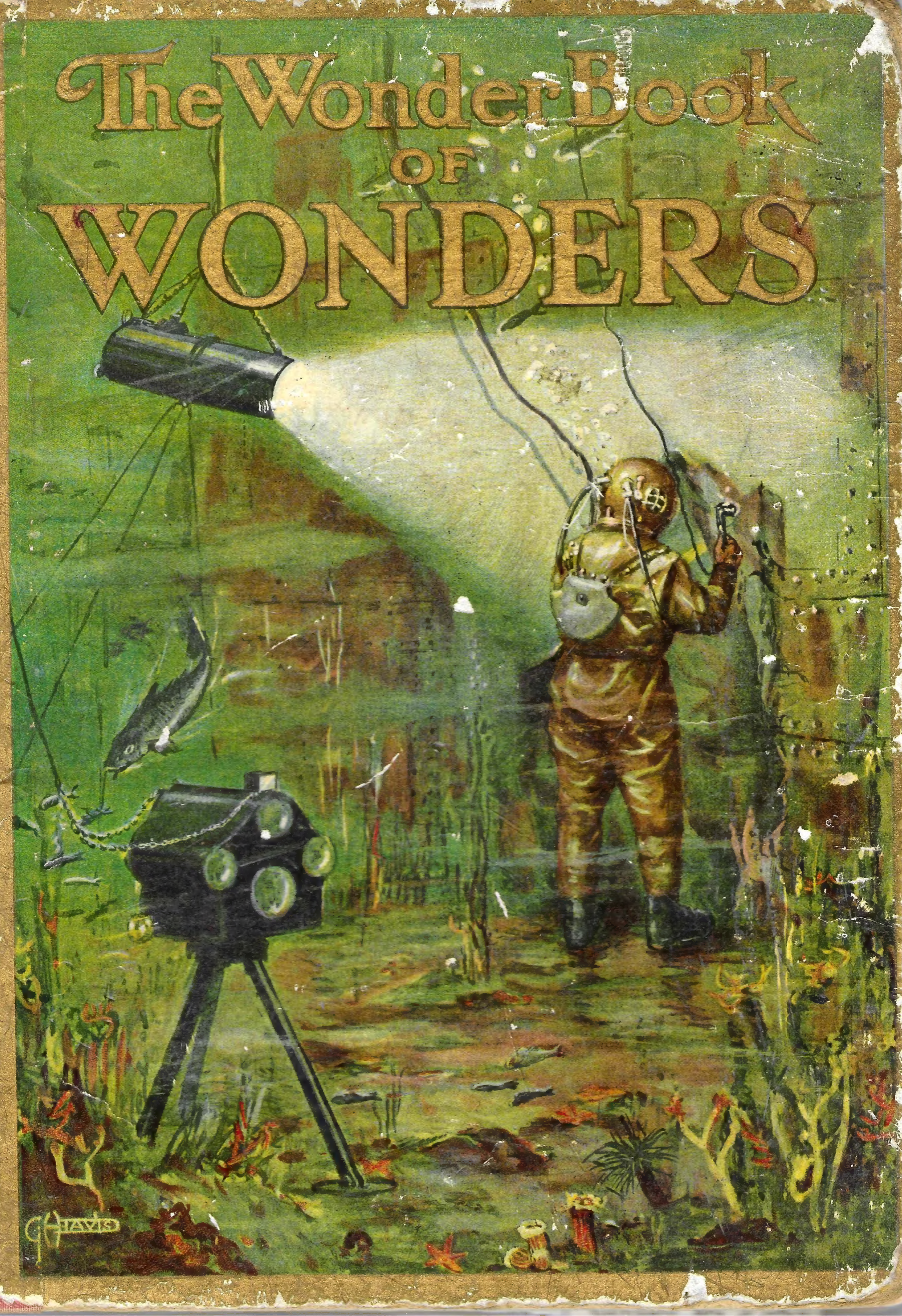
The Wonder Book of WONDERS



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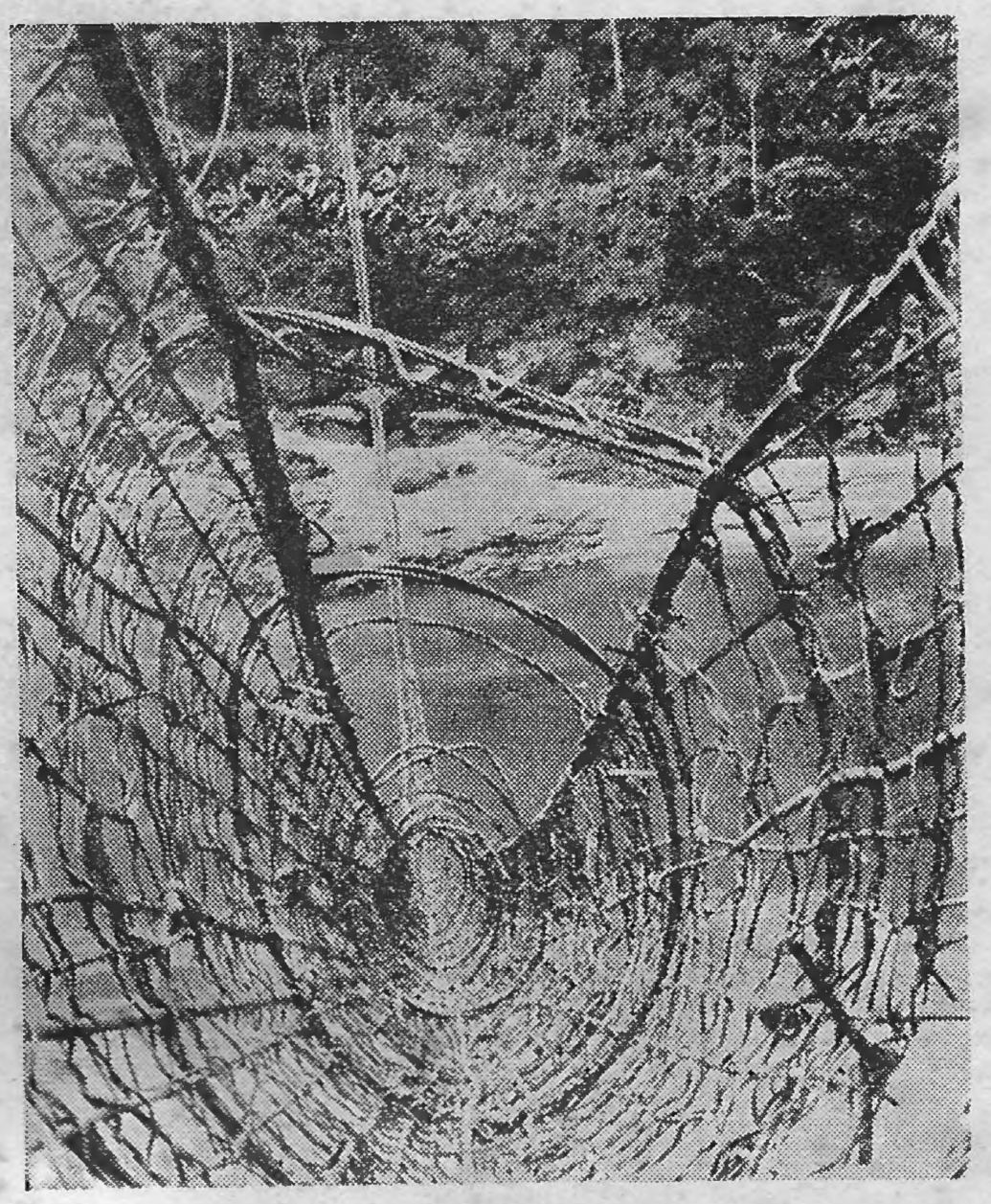
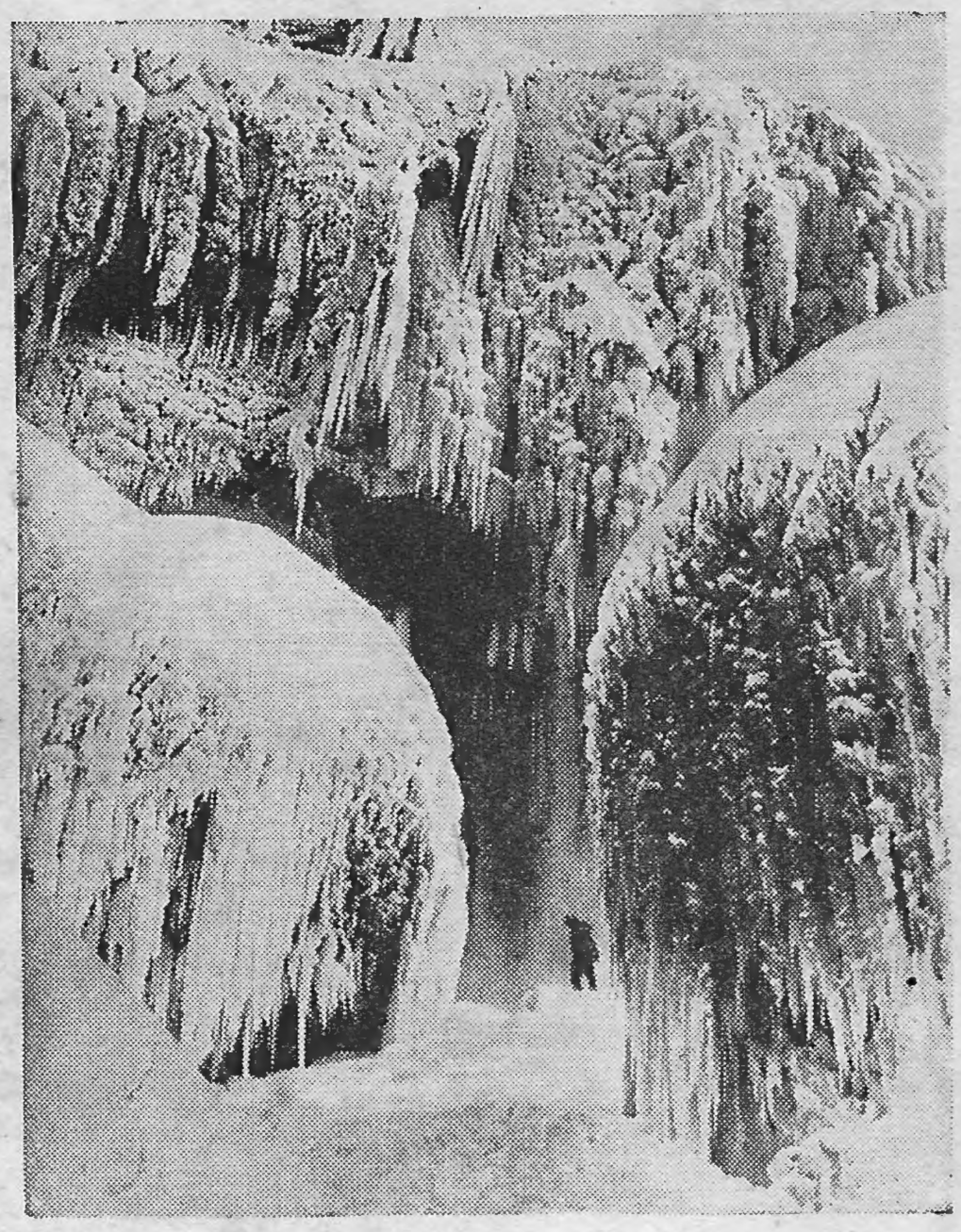


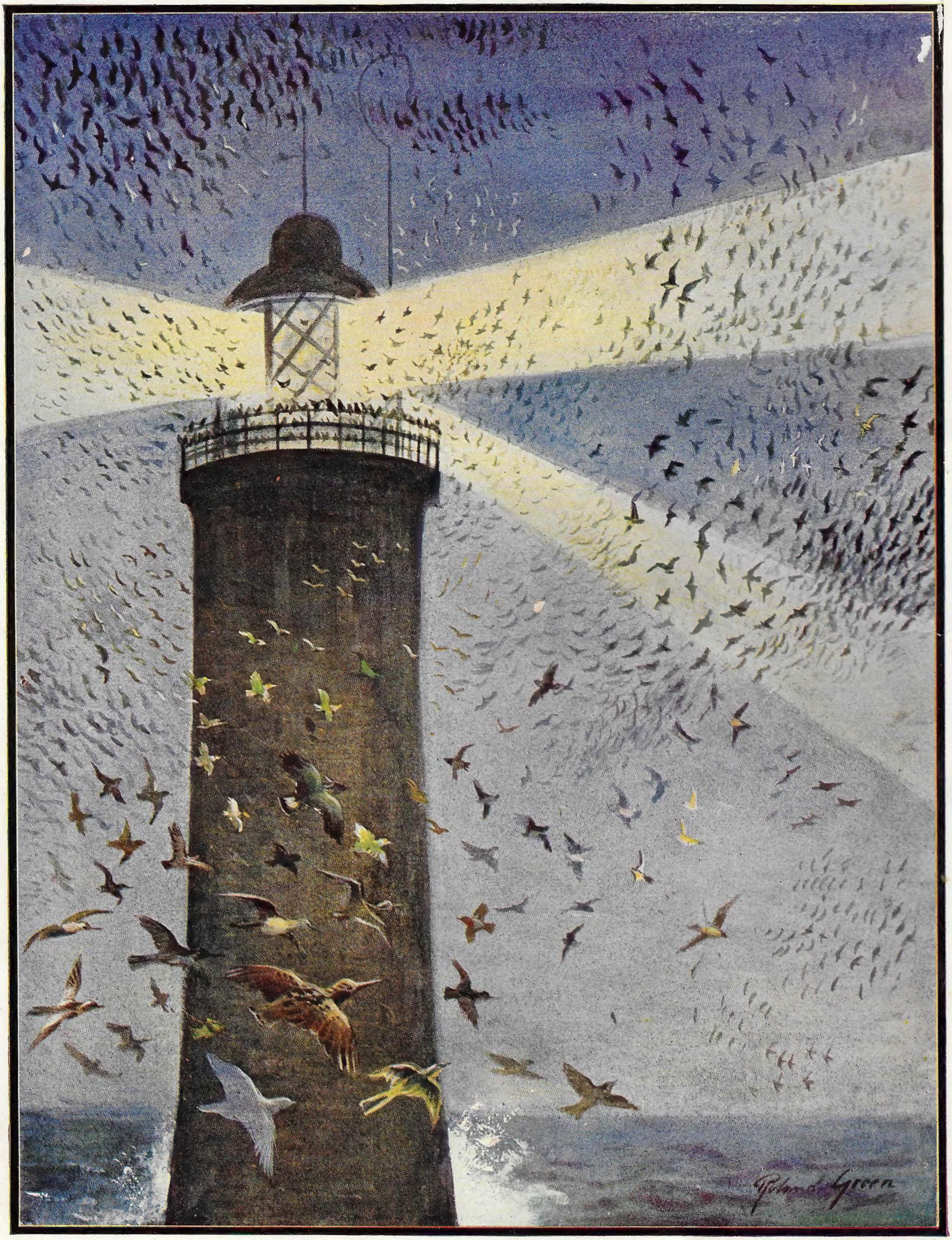
THE WONDER BOOK OF

WONDERS



[*Copyright photograph by Janet Allen and Agnes Martin.*

THE WONDER OF WIRELESS: THE CHILDREN'S HOUR.



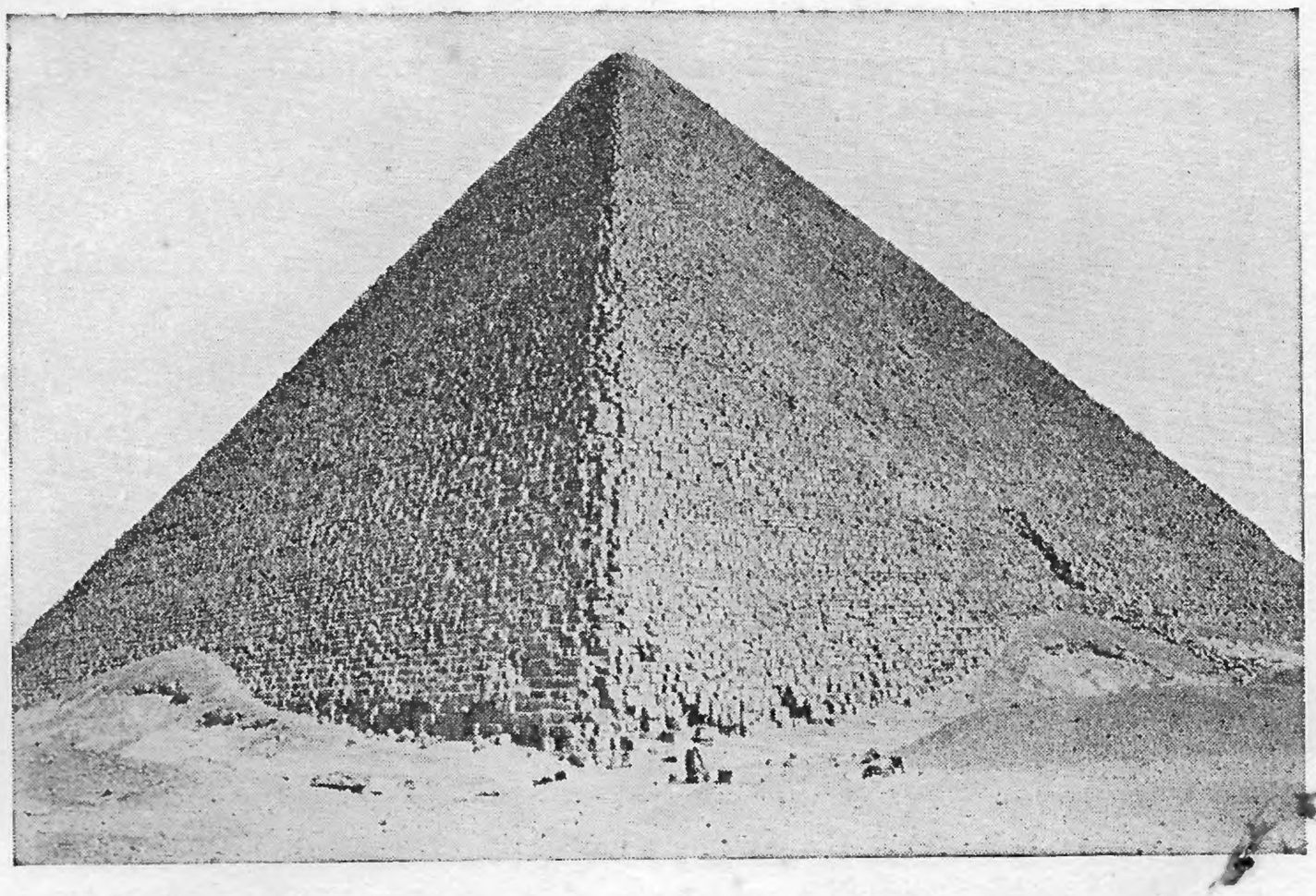
Frontispiece.

THE WONDER OF BIRD MIGRATION.

It is now quite certainly known that many migrating birds take journeys of thousands of miles, and the arctic tern is believed even to fly from Pole to Pole. In spring and autumn such a sight as this is familiar to lighthouse-keepers. The flights are made by night and nearly always in large companies.

THE WONDER BOOK
OF
WONDERS

"Oh, here and there is Wonderland
And anywhere will do."



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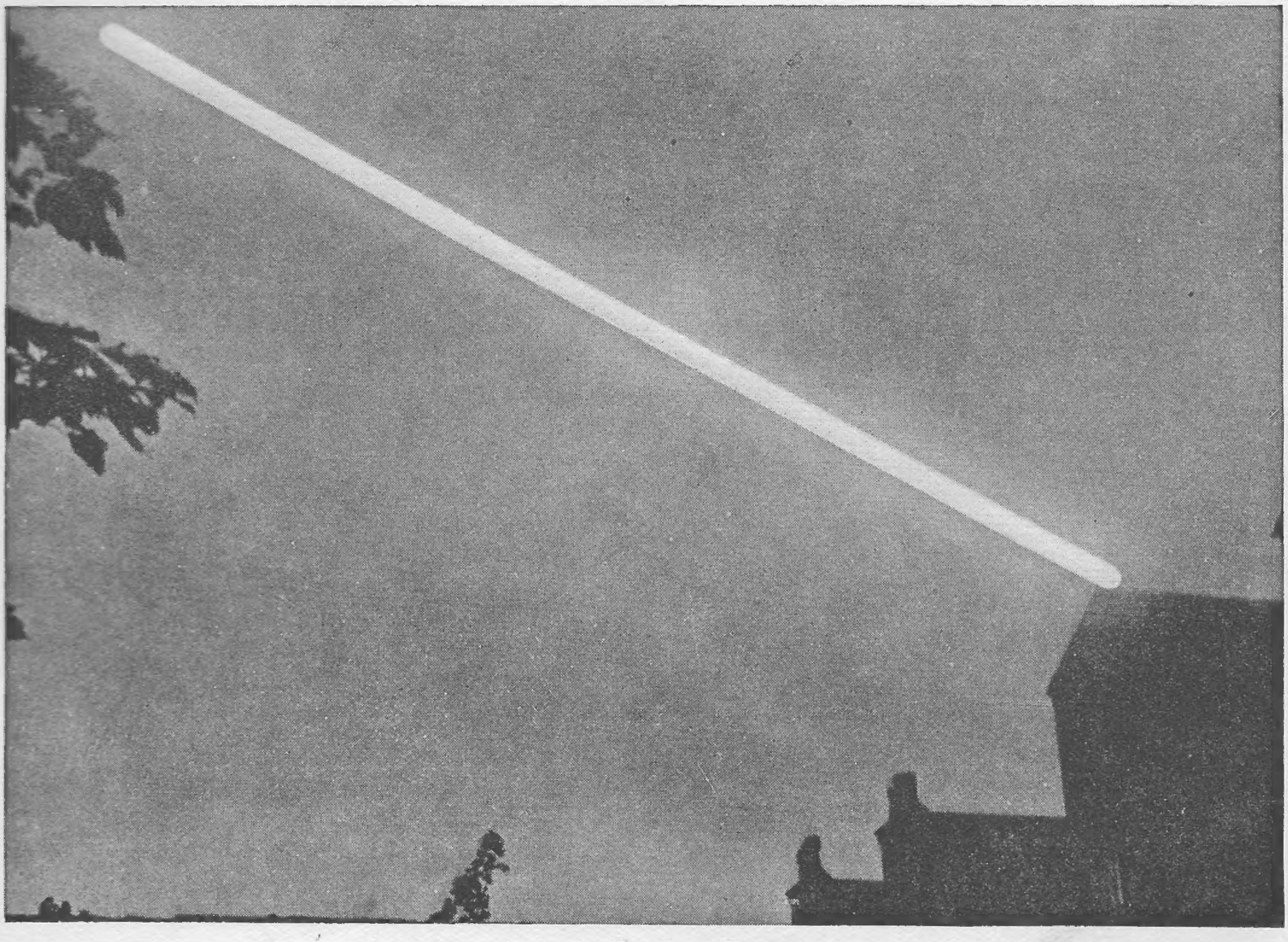

[*Special Press.*

THE PATH OF THE MOON.

The result of exposing a plate for two hours without moving the camera.

COLOUR PLATES

The Wonders of Modern Under-Water Salvage : A diver at work under sea, with acetylene blow-lamp, searchlight, camera, and other scientific apparatus (see p. 48). By *G. H. Davis* . . . . . *Front Cover*

The Wonder of Bird Migration. By *Roland Green* . . . . *Frontispiece*

A Sandstorm in the Desert. By *Howard K. Elcock* . . . . *Faces p.* 16

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A Wonder Building of India : the Taj Mahal. By *Frank Dean* . „ 208

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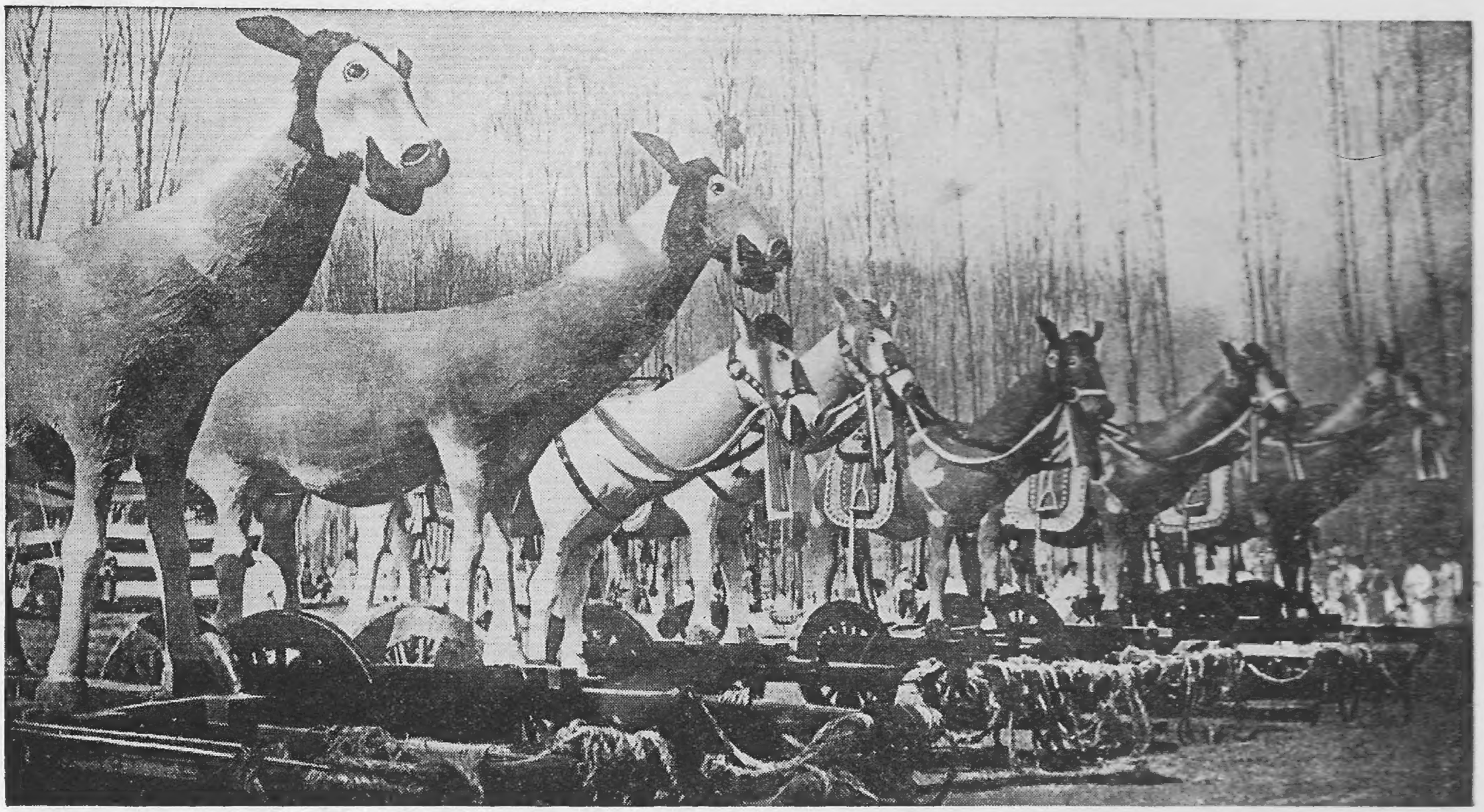

[*Illustrations Bureau.*

MONSTER HORSES AT A MONARCH'S FUNERAL.

These horses were provided to carry the spirit of a dead Emperor of Korea to the world beyond.

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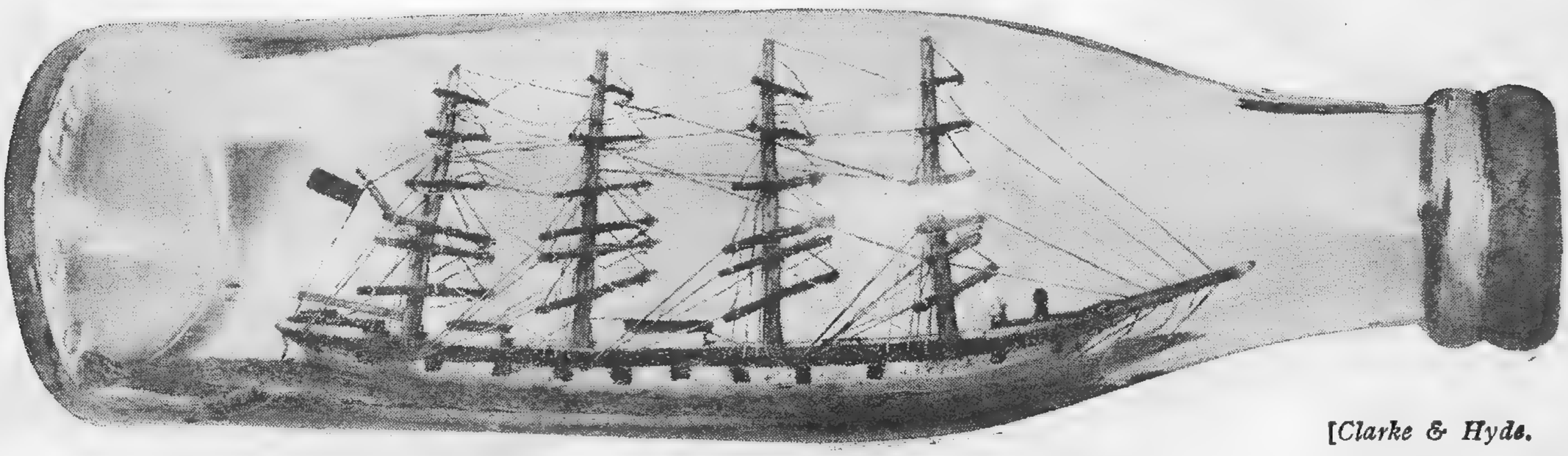
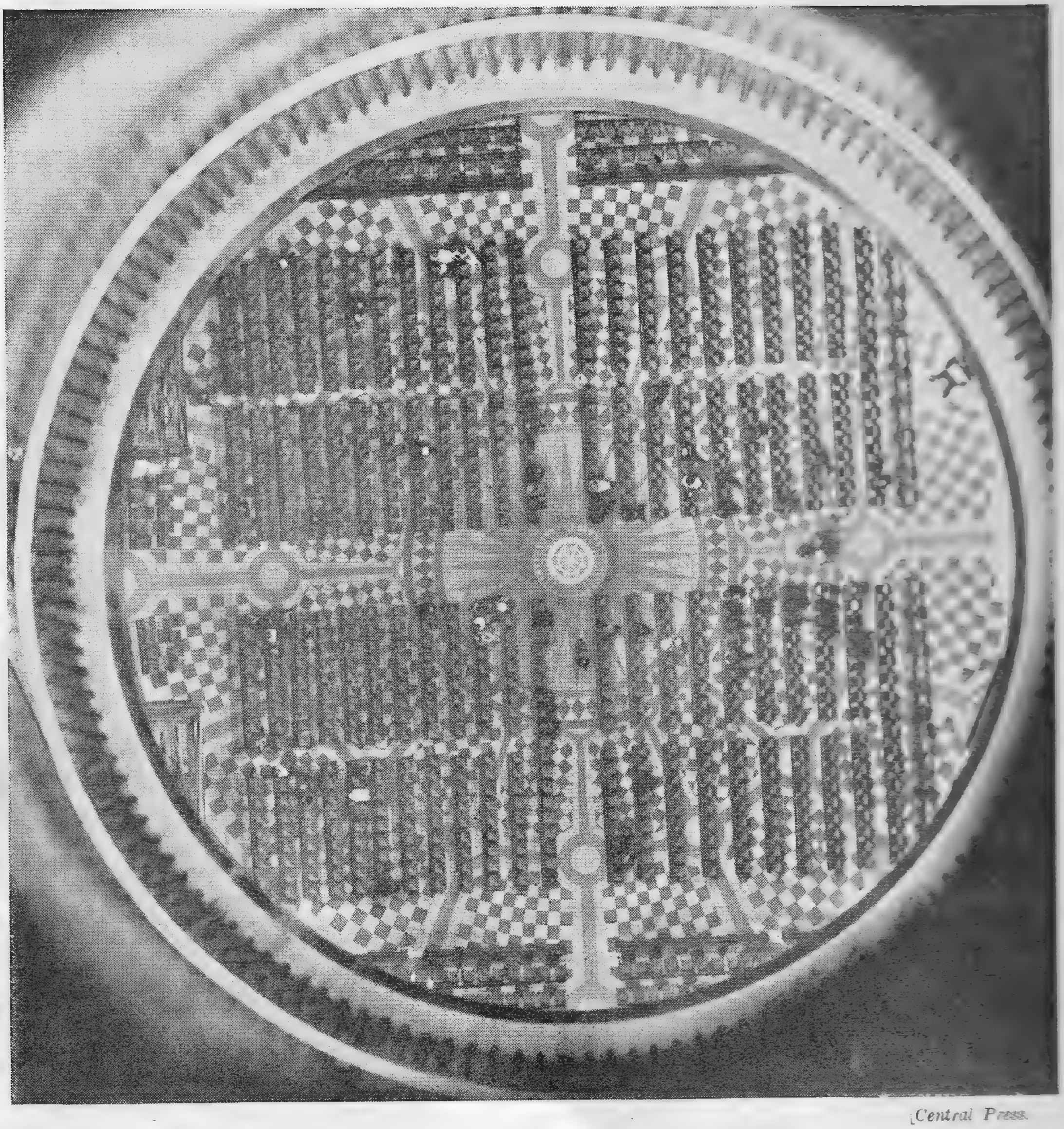


[*Clarke & Hyde.*

HOW DID THE SHIP GET INTO THE BOTTLE?

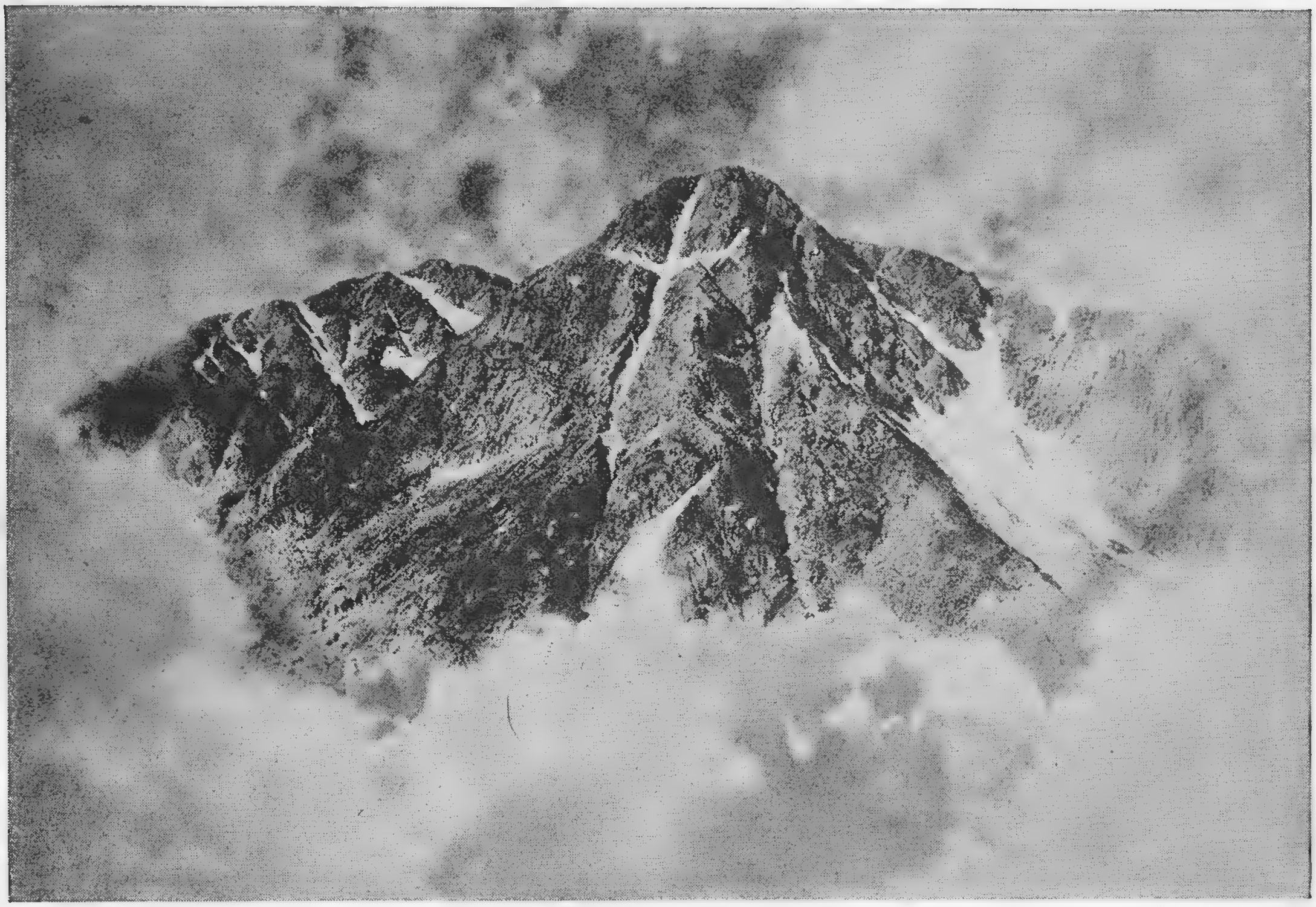
Sailormen are rather fond of puzzling their friends with this kind of thing. But any boy can do the trick. The ship is put in through the neck of the bottle with the masts lying down. They are then hauled up by means of a piece of cotton, and, the ends having been previously wetted with glue, are easily set upright.



[Central Press.

A WONDERFUL VIEW OF THE FLOOR OF ST. PAUL'S CATHEDRAL FROM THE DOME.

The photograph was taken from the top of the Dome, 300 feet above the floor. The congregation is seen seated for afternoon service. The central sun disc is directly over Nelson's tomb.



Topical.

A SNOW CROSS ON THE ROCKY MOUNTAINS.

Placed at an altitude of 14,000 feet, this natural wonder is seen far and wide. Only in the hottest seasons does the cross disappear.

Wonders—and More Wonders

"WE had the Seven Wonders of the World in class to-day, Dad," said a small boy; "do you remember them? And have you ever seen any of them?"

"Oh, yes!" his father began cheerfully. "I can name some of them: the Hanging Gardens of Babylon, the Tomb of—of—— the one in the British Museum, you know——"

"Mausolus," the boy answered.

"Yes, and the statue of Jupiter by Phidias, and—all the rest of them; but I have seen only the Pyramids."

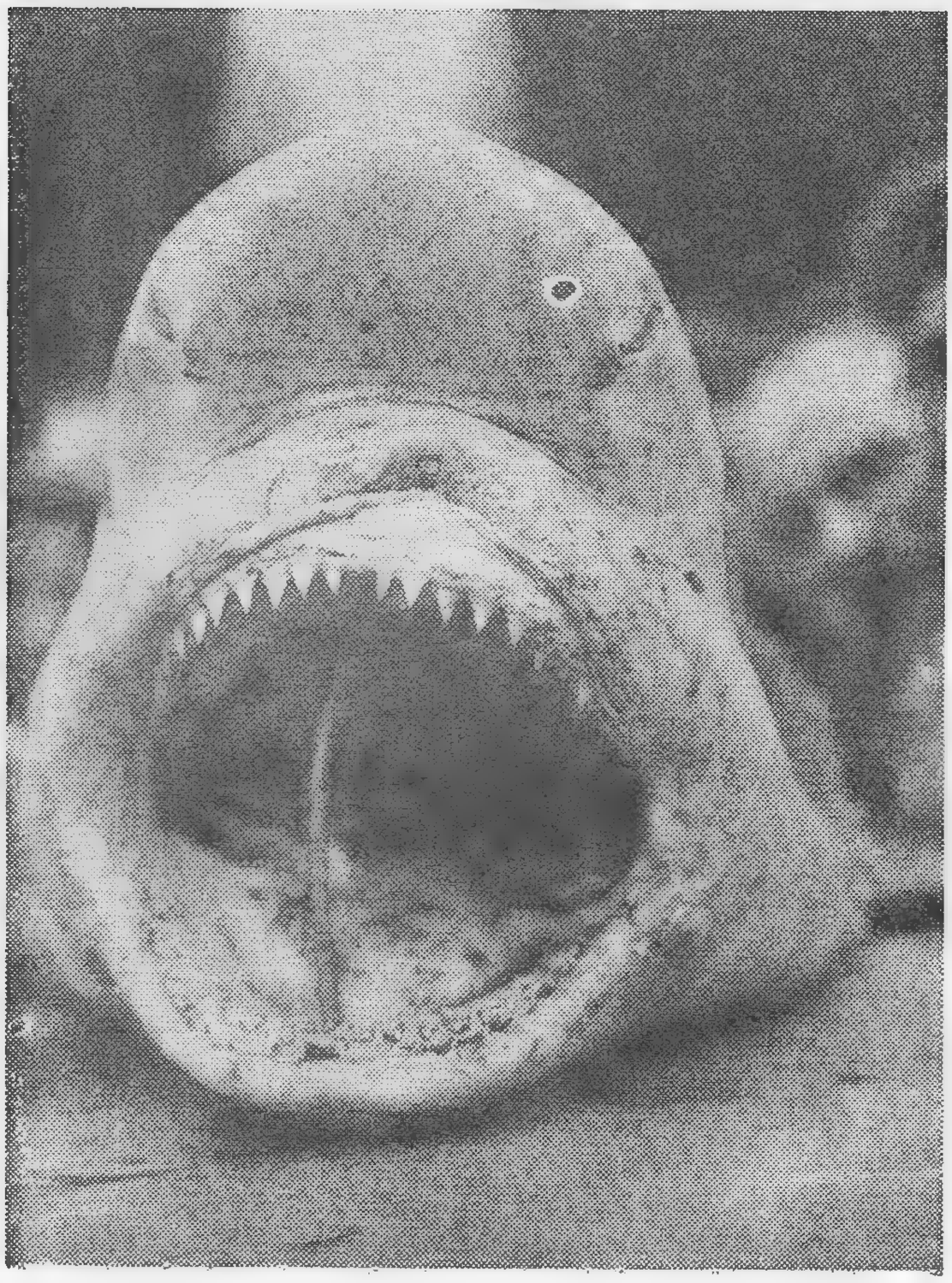
The boy smiled, but, being generous, he did not pursue the subject any further; he put, indeed, a question of another kind. "Dad, if you had to give the Seven Wonders of the World as it is to-day, which would be your first pick?"

His father asked for a little time to think over his answer; and when it was ready it was very much like the observations made on the next few pages.

. . . . . .

The Greek schoolboys had to learn the Seven Wonders, not because those were the only ones, but because they seemed to be the greatest. But to-day we should not be able easily to select the seven greatest. We should need to have *seventy times seven*, and then seventy times seven again. It is not hard to name seven wonders in the modern world; it would be very much harder to name seven things *not* wonderful. One of our poets has said that he has seen "nothing common" on this earth. That must be our aim. All knowledge begins in wonder. We ask "Why?" very early in our life, and we ought not to stop asking "Why?" Nothing then will ever become common; everything will be full of wonder, if only we keep our eyes open and our minds wide-awake. But boys and girls who have read the *Wonder Book of Why and What?* do not need to be taught *that* lesson.

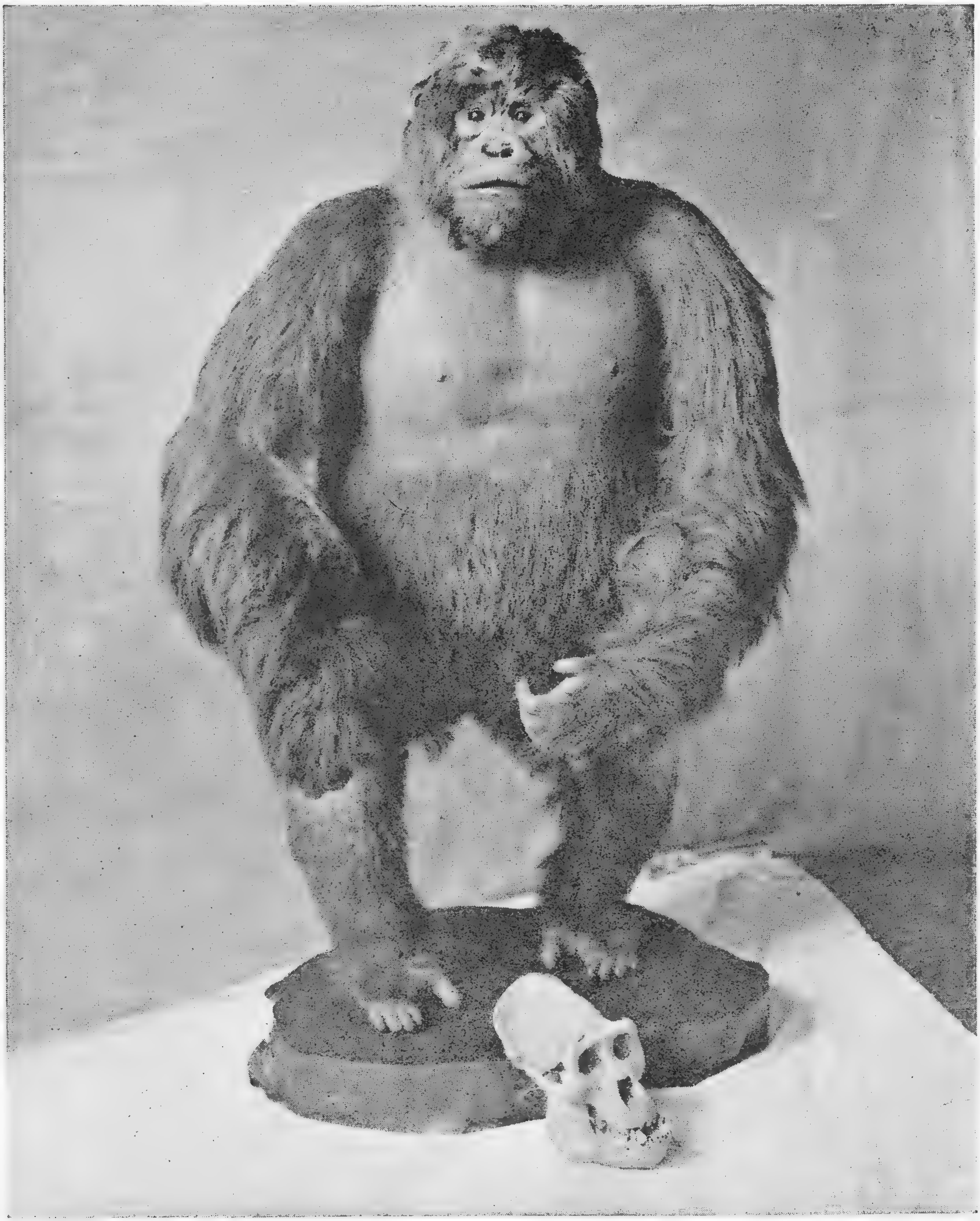
But what has come our way which the schoolboys in Athens and Rome never knew? We have no business to think ourselves better than they were; but much of the story of the world has been unfolded, and many of its secrets learned since those days. This will lead us not to wonder less, but more. Now, the Seven Wonders of the ancient world were all works of vastness or of beauty made by the art and skill of man. A building, a statue, a lighthouse—it was of things like that they were thinking. They looked out to see what were the greatest victories man had won upon the fields of earth. Here he had taken a block of stone and made of it a noble statue; here he had built a lighthouse to guide the sailors as they drew near the coast of Egypt. They were splendid builders in those days, and they knew how to make their works beautiful. But if we were to name the noblest buildings in the world to-day we should add a great many to the list. An English



[*Topical.*

HEAD OF A BLUE-NOSE SHARK.

This monster, caught off the coast of New Jersey, was 9½ feet long and weighed 250 pounds. In its stomach were found twelve smaller sharks that it had swallowed.



[Mounted in the Rowland Ward Studios, Piccadilly, W.

A MALE GORILLA.

This fine fellow, as mounted, stands a little over 5 feet, and his chest measurement is 5 feet 4 inches. He was shot in the Belgian Congo. Below is the skull of a gorilla, remarkably like that of a man, except for the receding head and the large ridges over the eyes.

[*E.N.A.*

A TOTEM POLE FROM ALASKA.

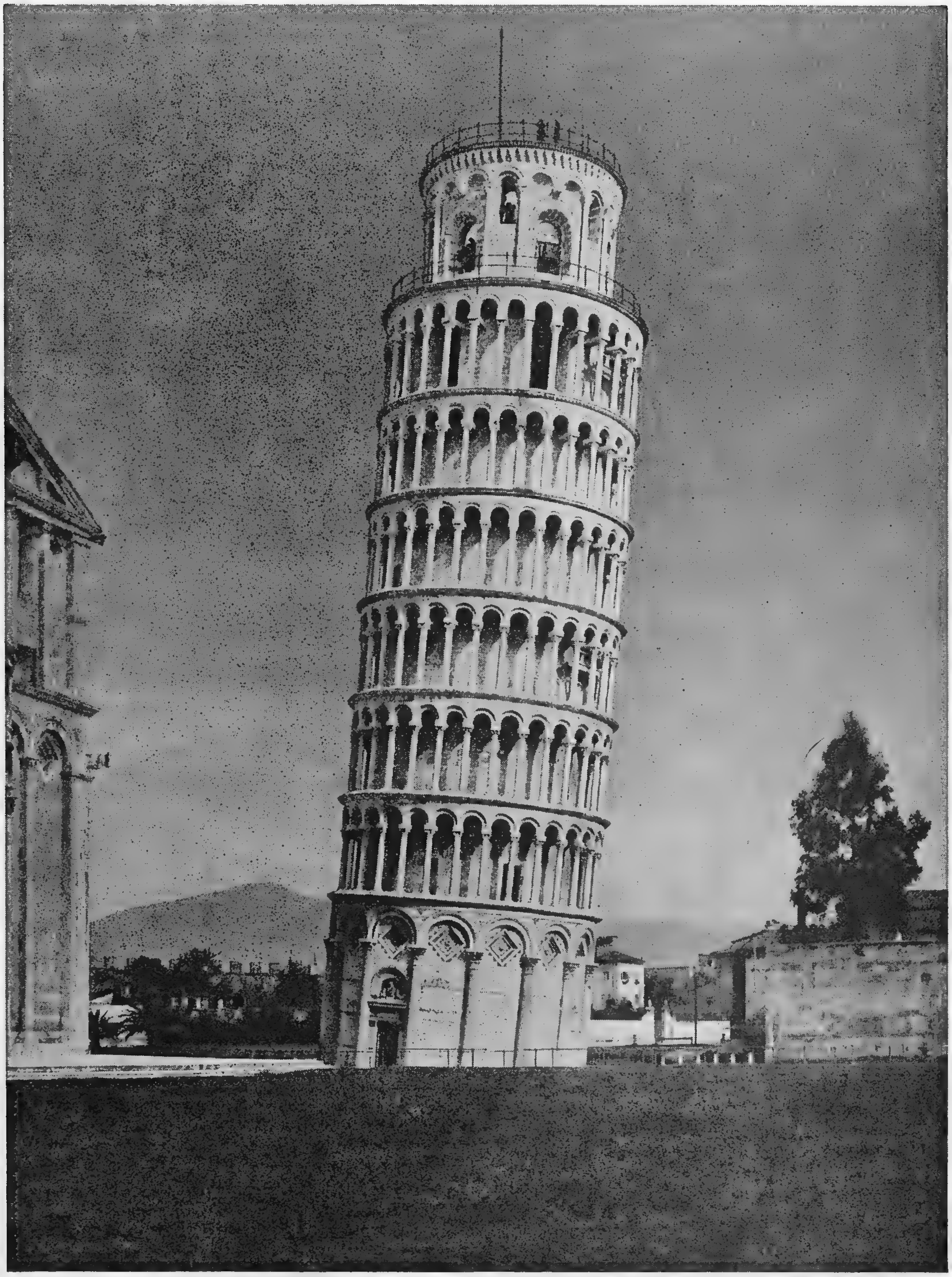
Nearly every Indian tribe has a "totem" (generally an animal or wild bird) which it holds in special reverence. Sometimes these poles record family or tribal histories.

boy would think of Westminster Abbey, a French boy of Amiens Cathedral, an Italian boy of the Leaning Tower of Pisa or Milan Cathedral. To-day we should not rank any ancient lighthouse among the most skilful of man's works; we might think of the Panama Canal, or the latest Atlantic liner, or the aeroplane. Man has always done wonderful things since first he began his life on earth; but many of his most wonderful buildings and works of art were made long after the little boys in the ancient world had learnt of the Seven Greatest Wonders.

But before we began to tell of the wonders man has made, we should remember all that man has *discovered*. We should go over the wonders of life as we have learned to read them in the life of the tiniest insect and in the boundless heavens. We should say first of all:—

"Great, wide, beautiful, wonderful World,
With the wonderful water round you curled,
And the wonderful grass upon your breast—
World, you are beautifully drest."

We should begin most likely not with the big, but with the very tiny things. There is the gnat which hums around you in the garden along with a very large team of other gnats. He is very unpleasant, but he is none the less one of the wonders of the world. He was that when the Pyramids were built; but we know more about him

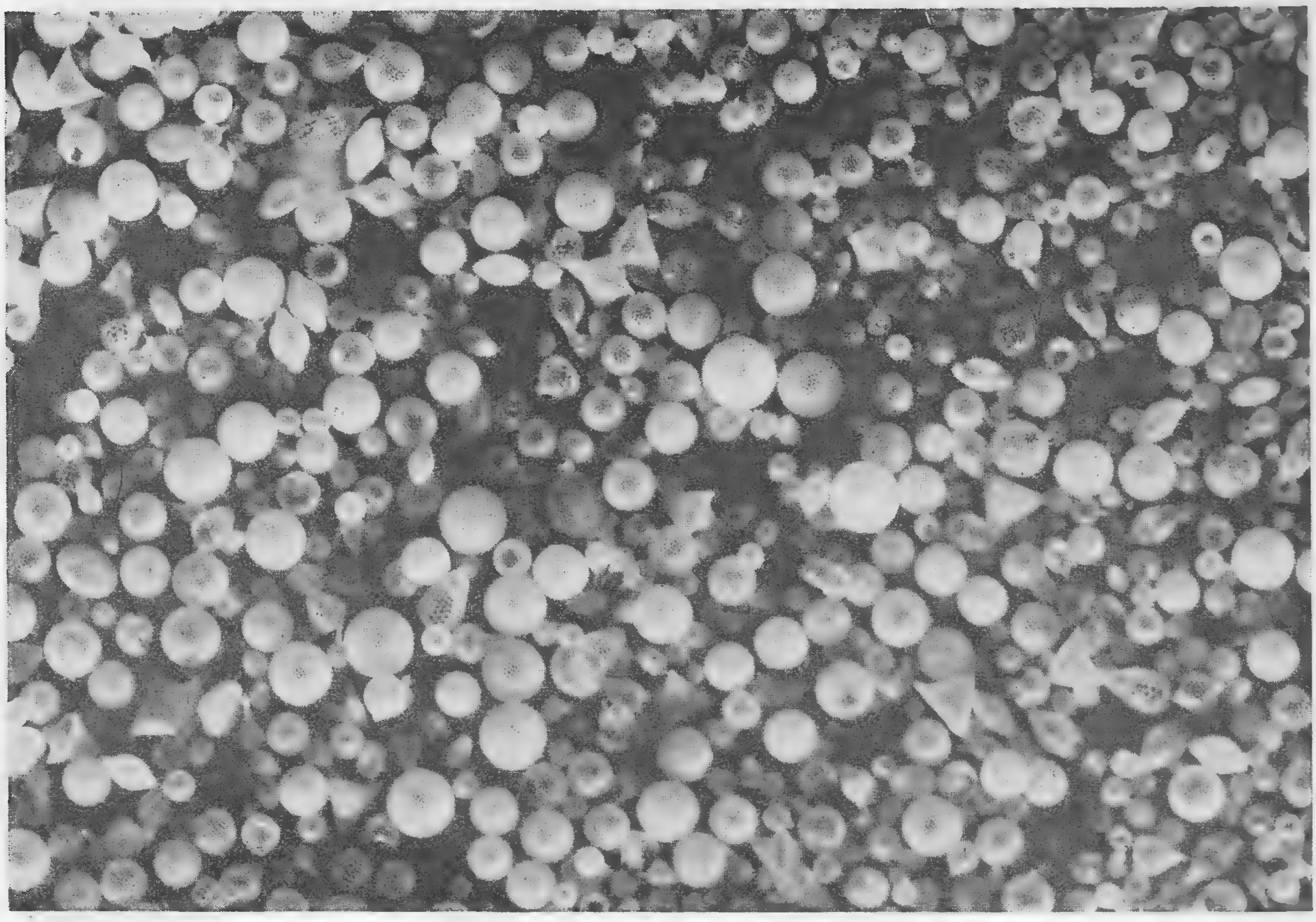


[*Donald McLeish.*

THE LEANING TOWER OF PISA.

Built in the thirteenth century, the Tower is 14 feet out of the perpendicular. From it Galileo made his famous experiments to prove that falling bodies, great or small, descend with equal velocity.

than the Egyptians did. From the time in the early spring when the gnat's boat of 300 eggs can be found attached to the water-weed till the hour when he splits the husk and escapes, his life is one long series of wonders. There was a great Frenchman, Fabre, who gave his life to the study of insects; and if anyone understood them he did, but he said at the end that life is full of secrets and no one would ever learn the last word concerning a gnat.



[*Ellison Hawks.*

POLYCYSTINS (GREATLY MAGNIFIED).

So small are these exquisitely beautiful creatures that three millions of them would scarcely occupy a cubic inch of space, and all of those shown above would form a mere speck. They are of many shapes, but all perforated through and through, and each "skeleton" was once the abode of an animal. They form a large part of the "ooze" on the floor of oceans and also of many rocks.

All living things are wonderful. When the great naturalist Darwin was asked what was the most wonderful atom in existence, he said the brain of an ant, "no bigger than a pin's head." If that seems doubtful we may look out an ant-hill on a warm summer day and watch the ants working together. Some of them are set apart to get food; others to fight; and there are officers and private soldiers in their armies, and even nurses for the wounded. If we watch them for a little while we shall agree that the brain of an ant is a marvellous

[*From a photograph taken at the Mount Wilson Observatory, California.*

A GROUP OF SUN SPOTS.

The sun appears to the naked eye to have a plain and perfectly placid surface. The telescope tells a very different story. Sometimes the flames are 500,000 miles or more in height. The dark parts shown in the photograph are "spots," often millions of square miles in area. Many worlds of the size of ours could be placed in a single spot and would scarcely be noticed.

thing. But when we read about the bees and the spiders, we find them almost as marvellous. More thrilling than any fairy stories are the life histories of these tiny creatures. But there is something which we cannot forget. What a wonderful being is Man, who has studied and found out all these secrets!

At the other end of the line of life are those big animals, the elephant and the giraffe, the friends whom we look forward to see when the trip to the Zoo comes round. Between the very little and the very big there are a host of living creatures, all of them wonderful. Dr. Thomson tells us that of animals with a backbone there are 25,000 named and known, and of those without a backbone there are 250,000. It would be rude to inquire to which of these we belong, because, of course, every human being has a backbone. We are members of a very large family, and we may count the other creatures below man as poor relations; but when we consider how strangely and beautifully they are made, we shall not despise them. The garden at our doors on a summer day, with its insects busy upon their tasks, and the worms crawling over the ground, and the birds flying to and fro, will appear an enchanted land. All the world will seem full of wonders.

But it is not only to living creatures we should turn. There are

NEST OF TRAP-DOOR SPIDER, SOUTH AFRICA.

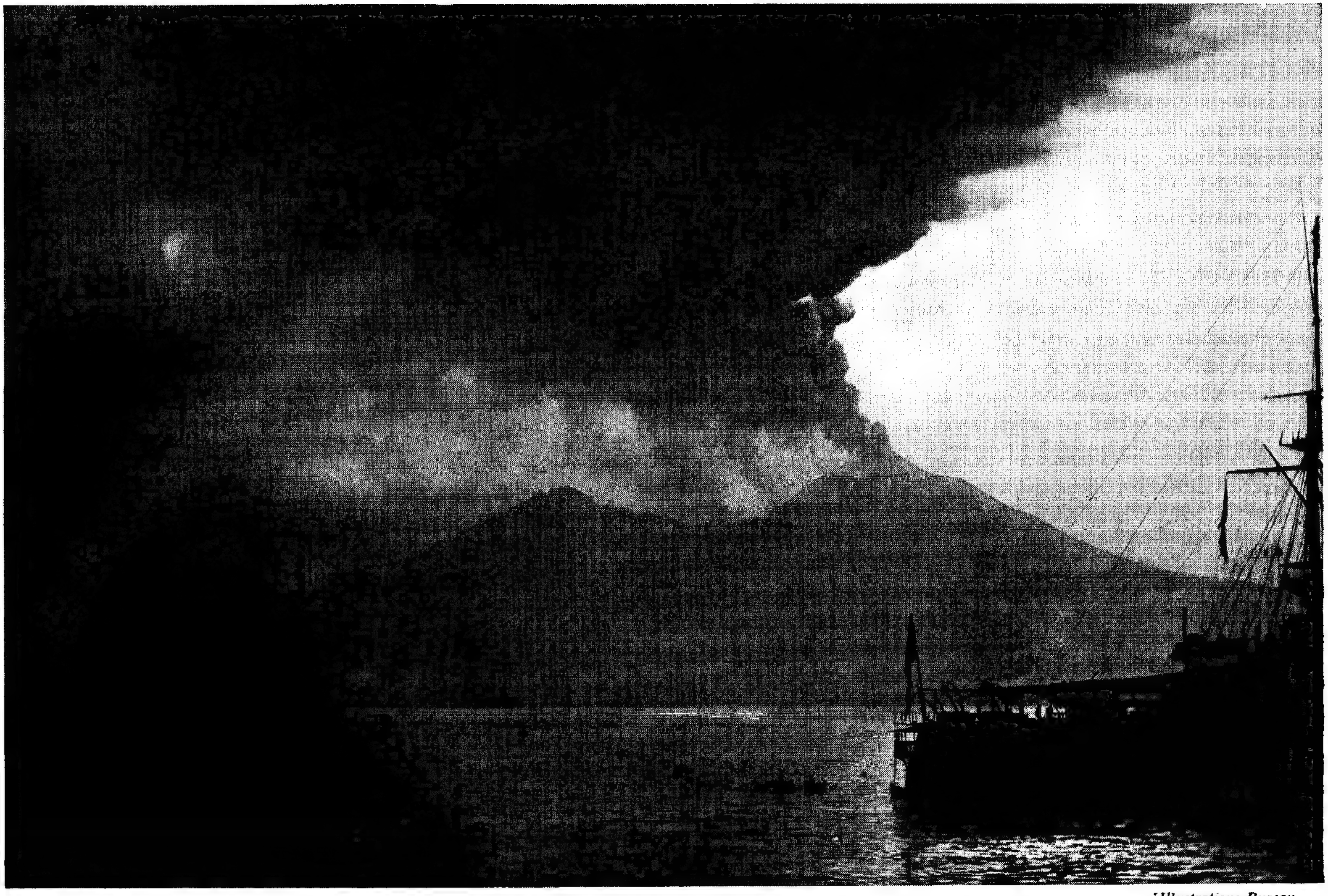
When the spider is within the door is closed and held so by the creature's mandibles and feet. The top of the door is "camouflaged" in such a way that it is most difficult to discover.

[*W. S. Berridge, F.Z.S.*

The nest dug out, to show depth. The tube is lined throughout with silk and the door has a silk hinge.

A SANDSTORM IN THE DESERT.

"Dust-Devils" is the name often applied to the whirling columns of sand that in Arabia, North Africa, and other desert regions will sometimes descend on the traveller with appalling suddenness, even when the sky is blue and cloudless. They sweep along at a terrific rate and with deadly fury, sucking up every article in their path. For man and camel alike the only hope is to lie prostrate on the ground until the worst is over.



[*Illustrations Bureau.*

VESUVIUS IN ERUPTION.

A wondertul photograph taken from a point eight miles distant. Places over which the vast smoke-cloud is blown are shrouded in darkness, while volcanic ash rains down and lies inches thick everywhere.

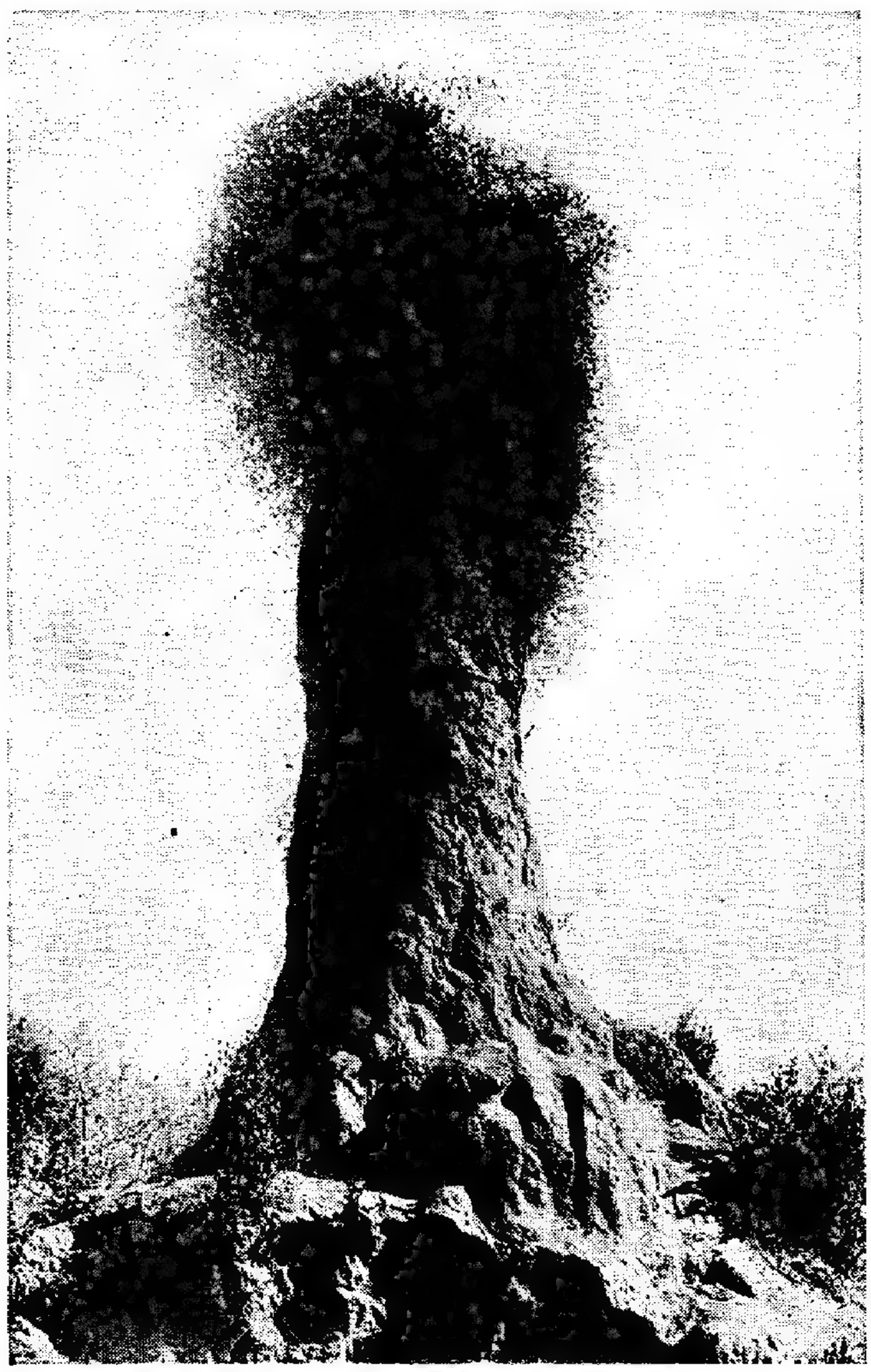
[*Topical.*

BALANCE ROCK, COLORADO.

This huge rock weighs 500 tons, yet is balanced on a base of only 4 feet.

Year after year it gives off rays of heat and light, *and it never loses its energy*. It has already done much in the hands of doctors, but all that this substance can do the world is only beginning to learn. Think of rays that can pierce through metal a foot thick!

Those same fathers of ours used to think that there was a something called an "atom," and they thought that when they had got to that they could go no further. Not at all! That atom is itself, so the wise men have learned, like a great world within which there are other worlds. There is no getting down to the powers hidden through all the ages of the earth, and only in these days discovered. When our fathers went to school they learned a list of elements known to chemistry. But in that list they learned nothing about *radium*. There is not much of it even now in use—only a few ounces in the world. To find one gramme of it a cart-load of pitch-blende has to be treated. But think what radium can do!



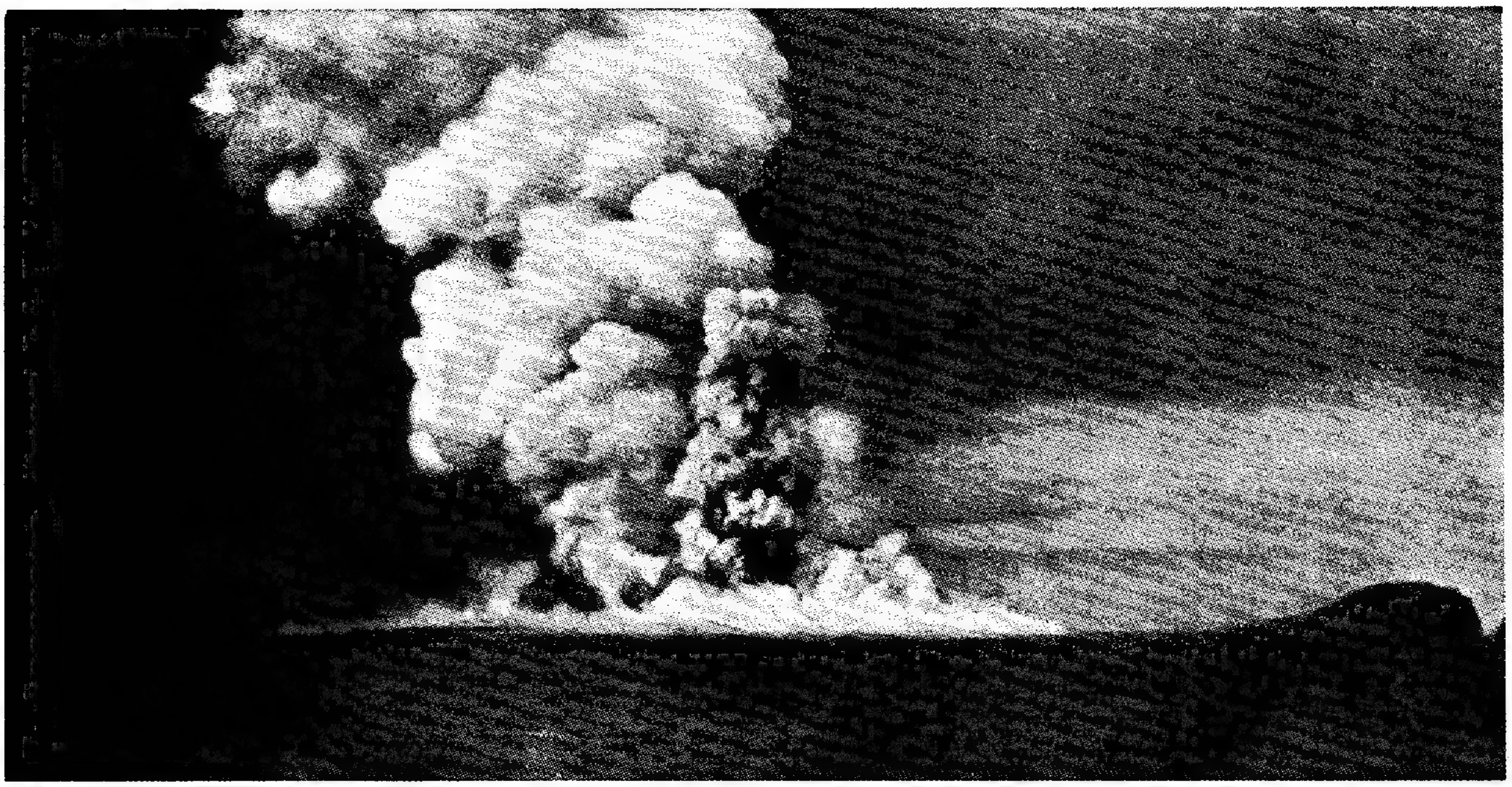
[*Special Press.*

A MONSTER TERMITE MOUND IN SOUTH-WEST AFRICA.

The work of the destructive termites, or "white ants," which are the terror of settlers. This heap is 25 feet high, and growing from the top is a bush. Termites are not really ants at all, though they live in similar communities.

least things. Science knows no boundary either way; it cannot say that it has reached the biggest things, and it cannot say that it has found the smallest. Whenever it comes to anything vast and distant, it finds something beyond. When it reaches the tiniest atom, it finds a world within it.

It is a surprise to find how much the ancients knew about the stars in their courses. But we can read more in the skies than they could. It is a long time since the Battle of Hastings was fought. But this very evening a ray of light may reach your eyes which left a distant star on the day when Harold, King of the Saxons, fell in battle. The light which comes to us from the nearest star left it over



[E.N.A.

BOGOSLOF ISLAND, ALASKA, IN ERUPTION.

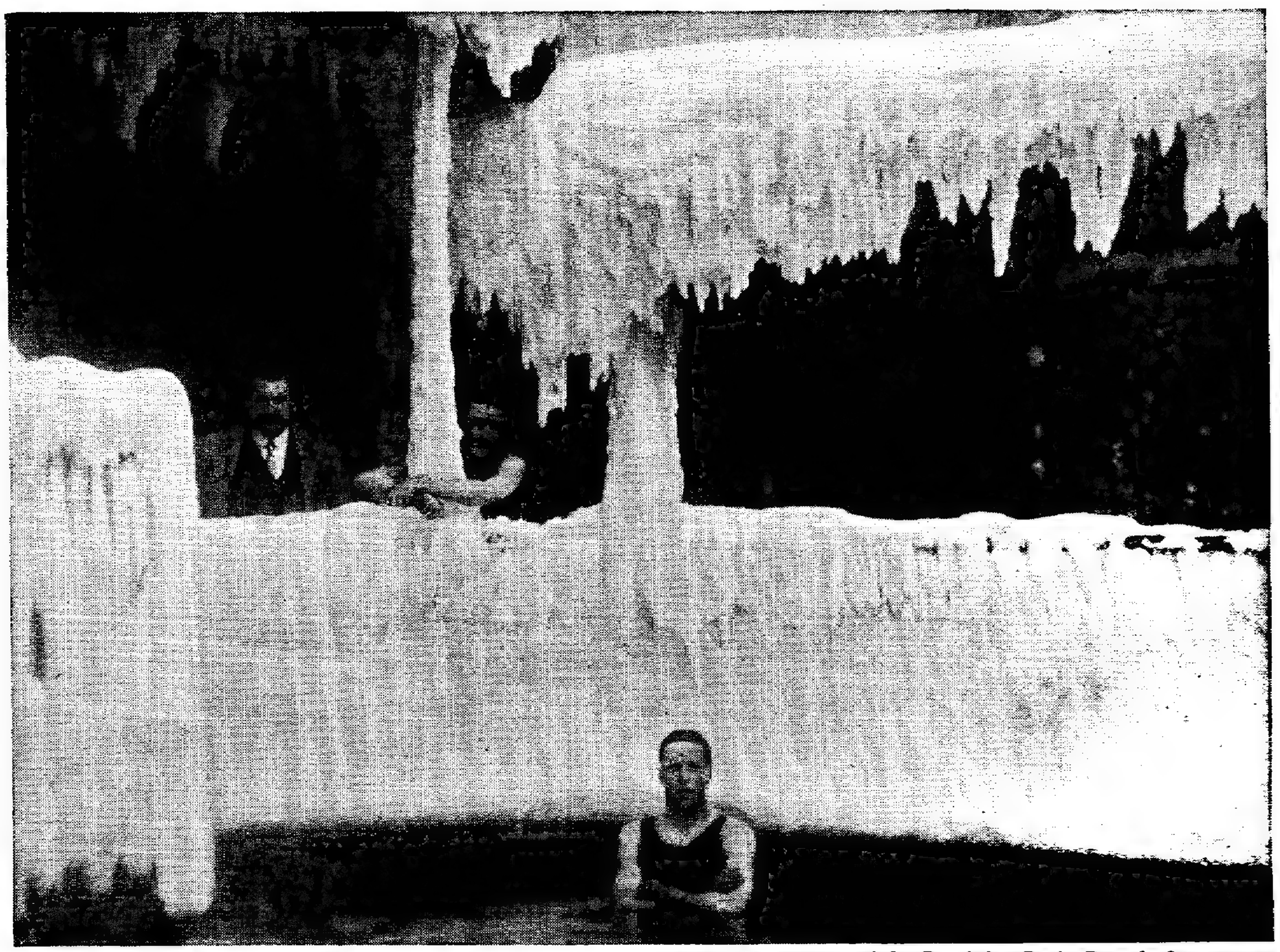
This is a sort of "Jack-in-the-Box" of the sea. One day there is an island here; then there is a group of them, then one island with several volcanic peaks on it.

four years ago. If in the least atom there are worlds and worlds, in the starry heavens there are hosts of worlds farther away and bigger than we can imagine. The microscope helps us to see the wonders of the smallest things; the telescope and the camera show us the wonders of the starry heavens. It would be hard to choose between the microscope and the telescope as roads into wonderland. But the ancient world had neither the microscope nor the telescope.

The more man has learned of his dwelling-place, the earth, and its wonders, the more he discovers that he can use the knowledge to make his life fuller and more powerful. He can use the knowledge for evil if he likes, but he can use it for his good. He has learned how to

use steam and electricity, and if some boys of the ancient world came back they would be astonished at the railway train and the motor-car, and most of all at the aeroplane. And for a crowning wonder there is "wireless." Some ship is in danger to-night; it will send broadcast its call for help, and from many sides other ships will catch the message and steam to the rescue. This is a marvellous thing, which we are the first to use. . . . But——

. . . . . .



[By courtesy of the Dominion Parks Branch, Ottawa.

BOILING AND FREEZING.

Even when the outside temperature is 20 degrees below zero, bathers in the hot springs at Banff, Canada, step into nearly boiling water.

The more that father went on, the harder he found it to stop. The "seventy times seven" did not prove nearly enough; and he had to leave out very many which he would gladly have added.

. . . . . .

This is where the WONDER BOOK OF WONDERS enters. It is not a book which describes *all* the wonders of the world, but it at least—like its companion volumes *Why and What?* and *Nature*—opens a door into the Aladdin's Palace within which we may live. It is not intended to

(E.N.A.

CLIMBING THE FRANZ JOSEF GLACIER, NEW ZEALAND.

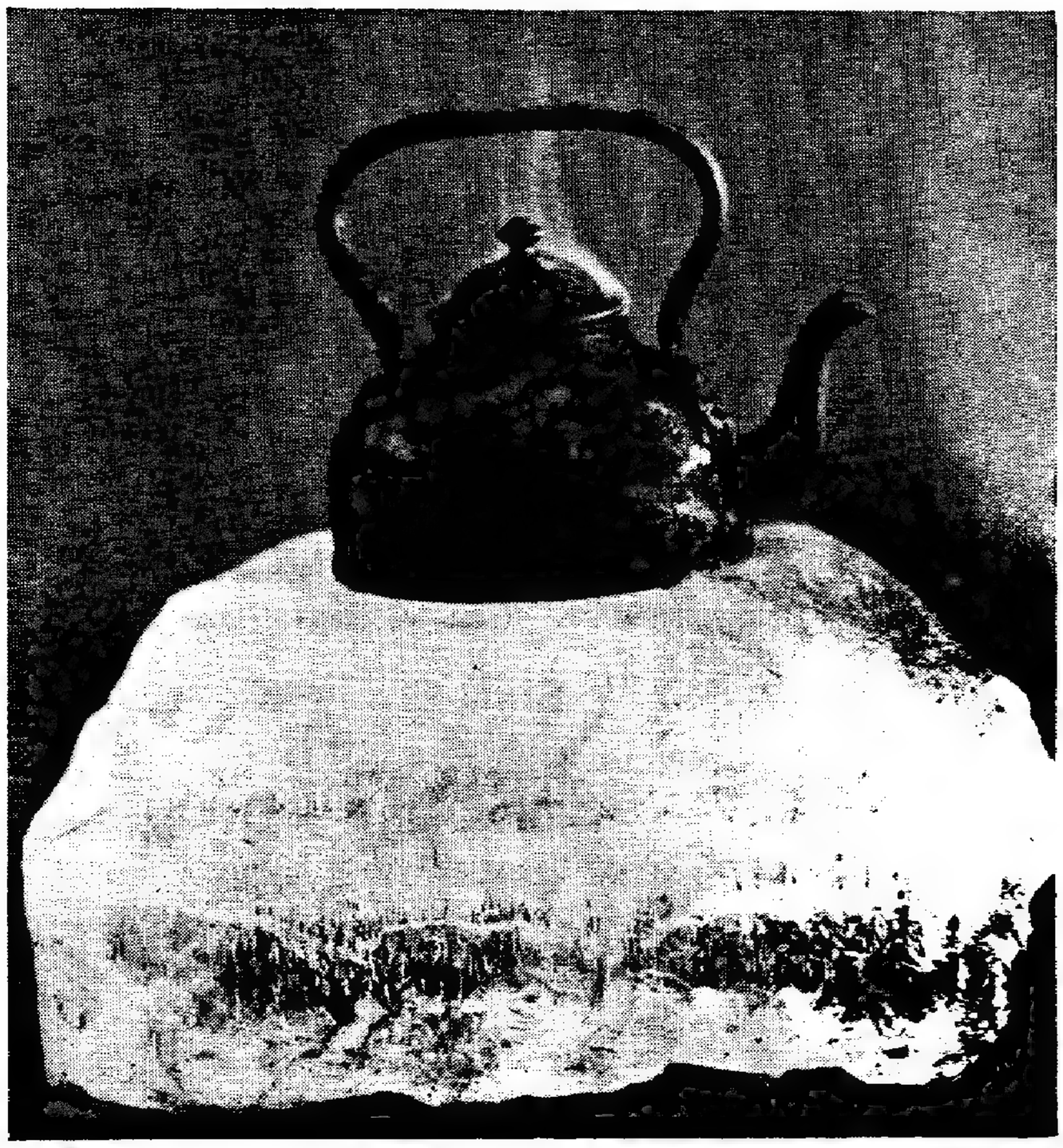
Few people who have not visited New Zealand realise the wonder and grandeur of the scenery. It has glaciers, mountains, waterfalls, and fiords equalling and even surpassing those of Switzerland and Norway.

make us cease to wonder; rather will it make us see in every moment and in every place more marvels than we can ever understand.

"Oh, here and there is Wonderland,
And anywhere will do."

The book will indeed sadly defeat its own object if it leads you to think there are no more wonders to be discovered. It does not close the story. It is really only an opening chapter. People in every time are always tempted to say that there is nothing left now. They always put romance and adventure into the past. But we must not believe them. Down every road Man has trodden he has found always new wonders. There are secrets still to be read in Nature's book; and there are mighty powers still to be called forth out of the earth for the service of mankind. Courage, then! There is a fair field before all. The very youngest boys and girls can be wonder-seekers and wonder-workers. They need not think they are born too late. Much has been learned; more, far more, remains to be learned. The wise of the ages do not say, "We have found out all there is to be known; you must receive it." They say, "We have made a beginning; you must carry on now; it is *your* turn."

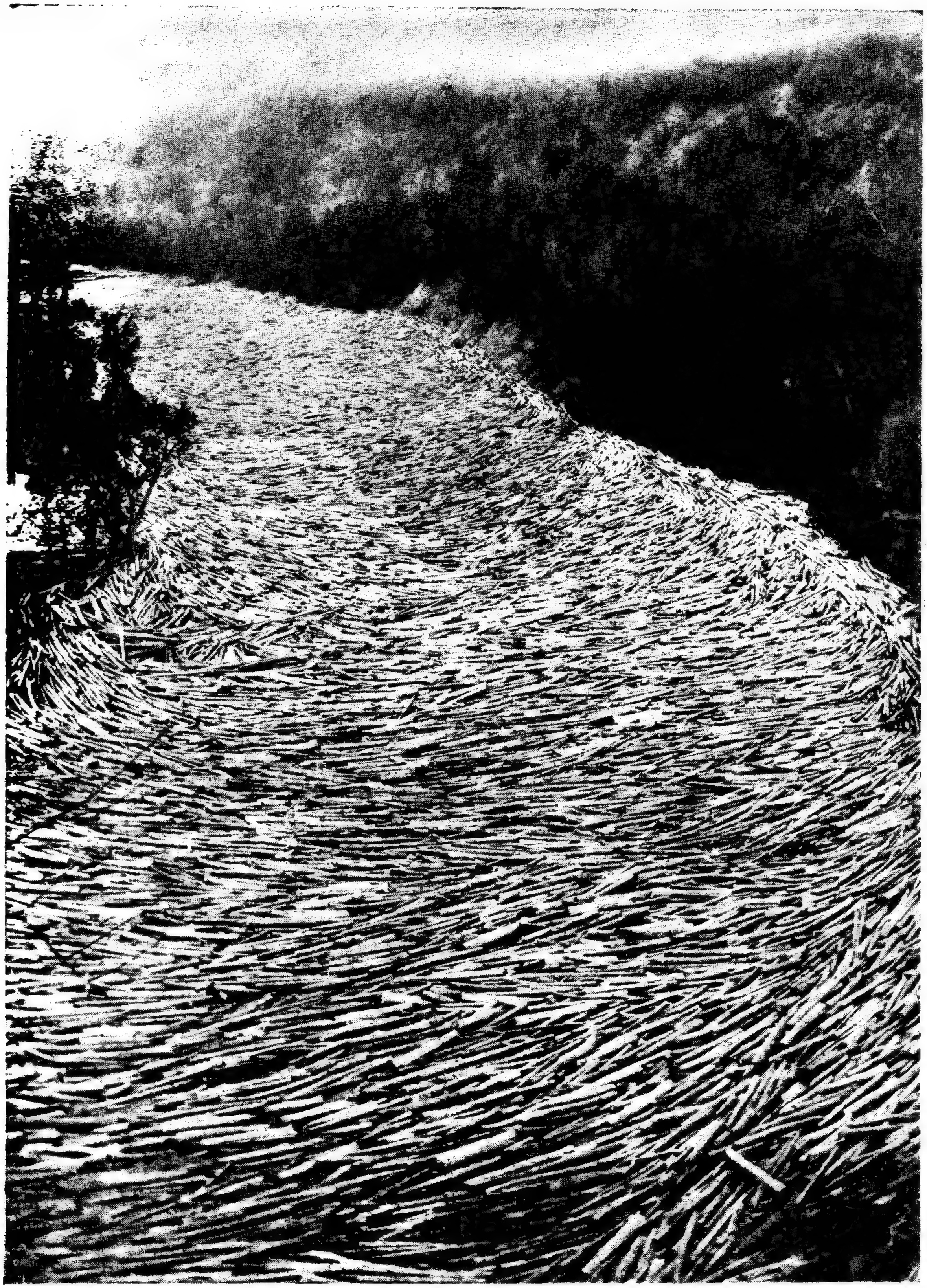
E. S.



[Underwood & Underwood.

BOILING A KETTLE ON ICE!

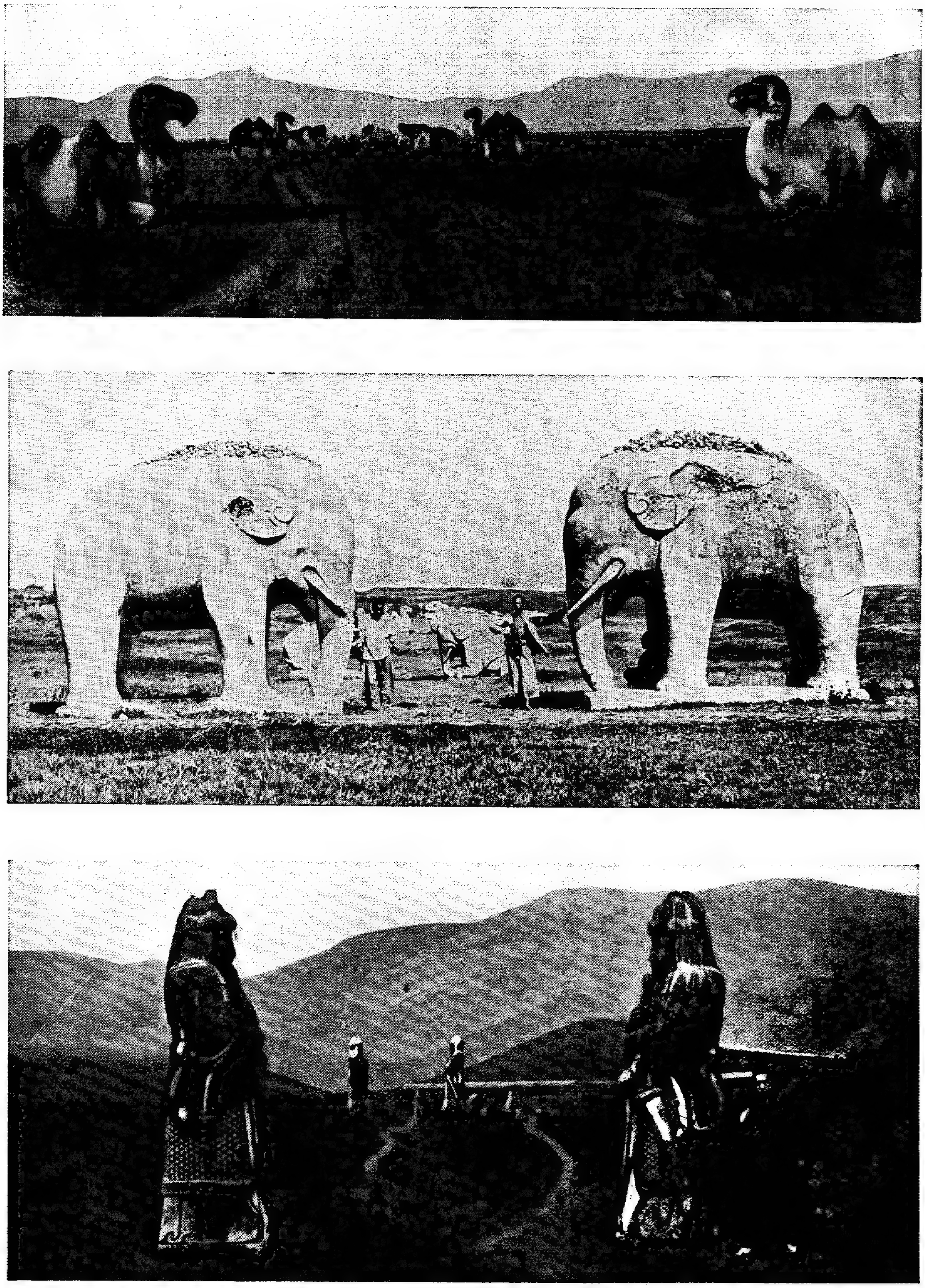
Liquid air has such a low temperature that ice is intensely hot in comparison and will raise it to its boiling point.



[E.N.A.

A RIVER OF LOGS, BRITISH COLUMBIA.

Millions of logs on their way down river. On arrival at the mills they are crushed to make pulp for paper.



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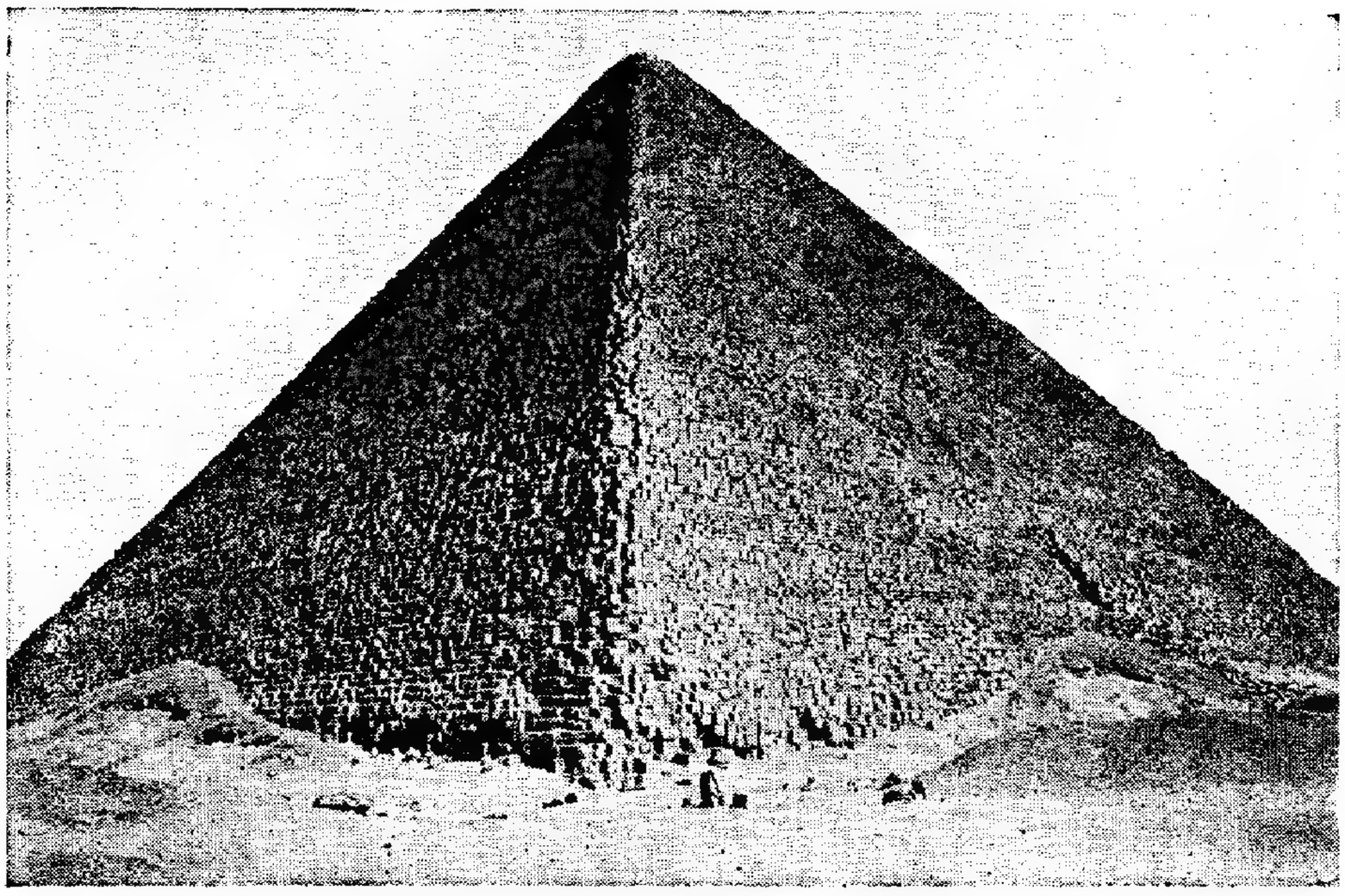
AVENUE LEADING TO THE MING TOMBS, NANKING: ONE OF THE STRANGEST OF CHINA'S MANY STRANGE SIGHTS.

In the tombs were buried the Emperor Tai-tsu (1368-1397), the founder of the Ming dynasty, and his queen. The tombs are approached by a long and roughly paved avenue, lined with fantastic stone figures of men and animals.



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THE GREAT PYRAMID OF CHEOPS.
Built between three and four thousand years B.C.

The Seven Wonders of the Ancient World

"THE Seven Wonders of the World" is a phrase which nearly everybody knows; but few people, if asked the question suddenly, as in the imaginary conversation with which this book opens, could tell what those wonders were. Only the Egyptian Pyramids survive to-day; the other six wonders have been destroyed in various ways, and descriptions of them by ancient writers are all that remain to give us a feeble idea of what they were like.

The Pyramids have been described so often that everyone knows what they are like. But in ancient times, when the Sphinx was a perfect carving, and a magnificent causeway of polished stone led up to the great pyramid of Cheops, the Pyramids must have looked far more wonderful than they do to-day, when the sands of the desert make them appear deserted and their polished casings have been torn away by treasure-hunters. For generations yet the Pyramids will stand as magnificent monuments of one of the greatest civilizations of the world, and as one of the greatest triumphs of the builder's art.

Even more magnificent were the walls and temple and "hanging gardens" of Babylon, of which hardly a trace remains. The walls

were over 300 feet high, with two hundred and fifty guarding towers of still greater height, and their circumference was said to be no less than sixty miles. The so-called " hanging gardens " were gardens built up to the height of the city walls on arches, on which terraces were laid, with soil on them so that large trees could root securely. Nebuchadnezzar built these gardens to please his wife Amytis, who, coming from the hills of Media to Babylon, wanted something different from the flat landscape of Babylonia to remind her of her native country. The gardens were laid out to represent hills and valleys and stretches of forest, all within the walls of Babylon itself.

Next among the seven wonders of the world was the statue of Jupiter Olympus, at Olympia, the centre of the worship of the Greek gods. It was designed by Phidias, the greatest sculptor of all time, and was of gold and ivory, a seated figure nearly 60 feet in height, on a throne of gold, ivory and ebony.

Rivalling this was another " wonder," the Temple of Diana at Ephesus, where some of the most magnificent carving of the old Greek sculptors was executed. The famous Praxiteles designed and carved the altar, and the Temple itself was a marvel of carving, both within and without.

Fifth of the " wonders " was the Mausoleum, or tomb, of King Mausolos, erected by his wife, Queen Artemisia, in Caria, a kingdom of Greece. Visitors to the British Museum can see a reconstruction of this great tomb, which has given a name to all memorials of the kind since. Its chief feature was a colossal equestrian group carved in marble, which stood 140 feet above the level of the terrace on which the monument was placed.

The Pharos, or lighthouse, of Alexandria, a mighty tower designed to guide ships into the harbour, counted as another of the wonders of the world. It stood on an island at the entrance to the harbour, and at its top contained a beacon fire which could be seen at a distance of a hundred miles at sea.

The seventh of the wonders was also a harbour statue, the Colossus at Rhodes, referred to elsewhere in this book in the article on "The Glories of Greece and Rome." It was a brazen figure of Apollo, 120 feet in height, standing over the entrance to the harbour, so that ships entering were said to pass between its legs.

[*Illustrations Bureau.*

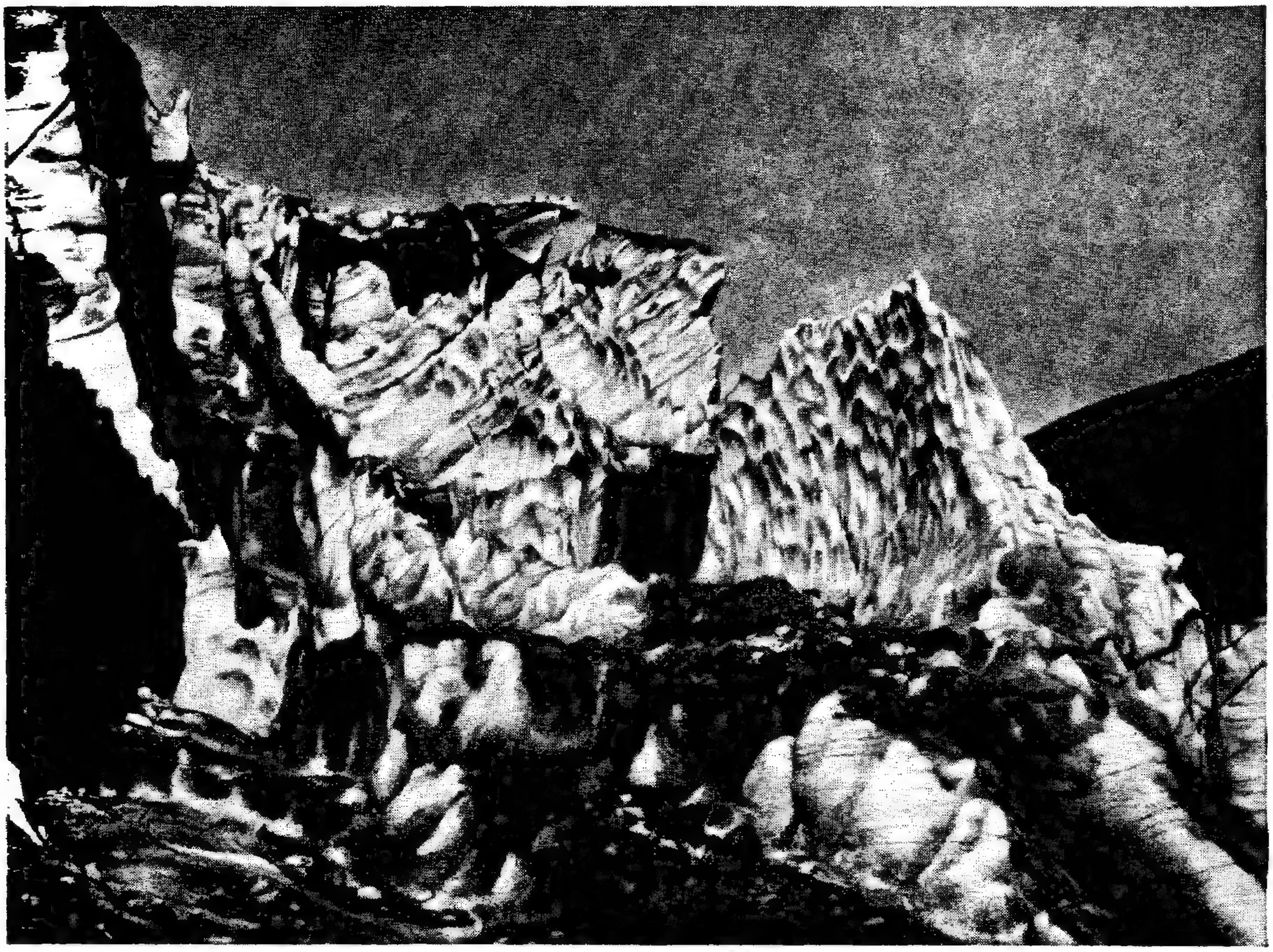
A MODERN COLOSSUS.

The Statue of Liberty, New York Harbour, with an aviator descending by parachute.

E.N.A.

A LONELY SENTINEL, ARIZONA.

Somewhere in this picture, if you can find it, is the figure of a man. The rock is so vast, however, that the man is smaller than an ant in comparison.



[E.N.A.

A HIMALAYAN GLACIER.

Note the curious "honeycomb" effect of the sun's heat and the way in which the ice has been contorted. This gives a good idea of the difficult country the explorers of Mount Everest had to traverse.

Some Wonderful Mountains

THE highest mountain in the world, Everest, in the Himalayas (29,002 feet), was unknown to Europeans until about seventy years ago, when it was discovered from the plains of India, and its height measured by the method known as triangulation. It is so surrounded by other great mountain-peaks that, although it is nearly six miles above sea-level, it can only be seen from two or three places in India.

Although visible from India, Mount Everest stands on the borders of two "forbidden countries," Tibet and Nepaul; up to a few years ago Europeans were not allowed to enter either of these countries, and it was impossible to get near enough to Everest to explore the country round it.

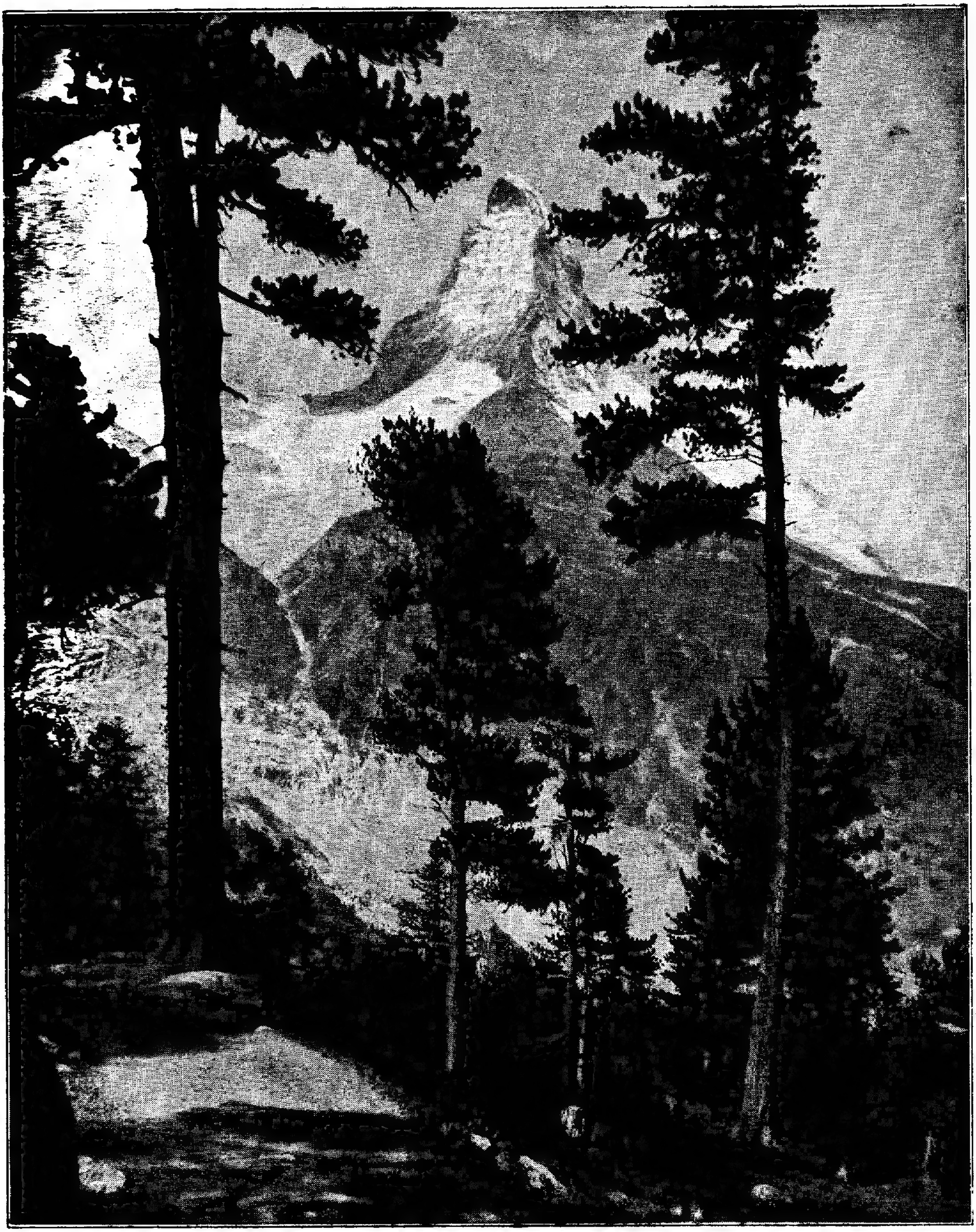
In 1921 permission was at last given for a party of British mountaineers to approach Mount Everest, with the idea of surveying

it and, if possible, reaching its summit. The journey proved one of the most wonderful ever undertaken, thousands of square miles of utterly unknown territory being traversed and mapped. The explorers passed through every sort of climate as they went up ; in the valleys were tropical forests and sand-swept deserts ; on the middle heights they found a climate much like that of Great Britain, and up near the mountain-tops they were in a region of perpetual snow and ice, with great glaciers grinding their way between the peaks, and icy winds for ever blowing.

[*Underwood & Underwood.*

NEAR THE SUMMIT OF MONT BLANC.

The party got within a mile or so of the summit and then had to turn back, since with the coming of winter it was impossible to attempt the last and most difficult part of the climb. In 1922 a further expedition was sent out, and after several attempts reached the height of 27,300 feet. So rarefied is the air at this great height that the gallant climbers had to carry apparatus for supplying oxygen, which of course was a considerable addition to their burden. After five nights had been spent in succession at 21,000 feet and two at 25,500 feet, the monsoon broke and the explorers, frost-bitten and exhausted, had to abandon any further attempt. In 1924 another attempt was made

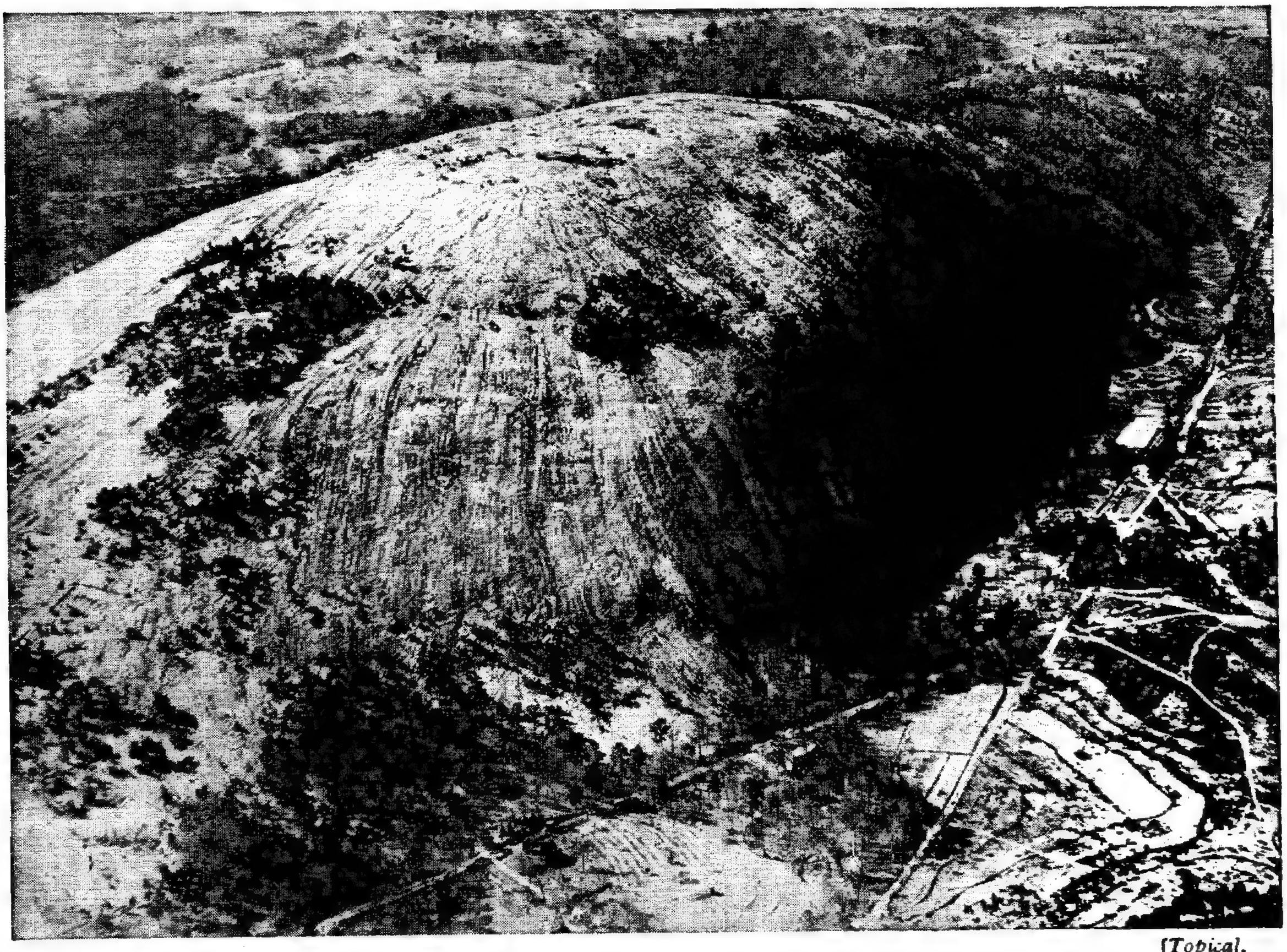


[*Donald McLeish.*

THE MATTERHORN (14,785 feet).

One of the most famous and shapely of Swiss mountains.

and two of the gallant climbers, Messrs. Mallory and Irvine, were seen at a height of 28,227 feet—less than 800 feet from the top. They lost their lives, however, and it will never be certainly known whether they actually reached the summit. Undoubtedly, sooner or later, the highest point in all the world will be attained, and though there may be nothing gained materially, Man will have added another to his long and heartening list of difficulties overcome.



[*Topical.*

A MEMORIAL MOUNTAIN.

Stone Mountain, Atlanta, Georgia, U.S.A. (700 feet high), is a solid block of granite. Round it are being carved colossal figures, some of them 50 feet high, as a memorial of Confederate soldiers who fell in the great Civil War.

The great mountains of the Alps, although not nearly so high as Everest, provide just as exciting climbing, and some of the most beautiful scenery that can be imagined. Mont Blanc, the highest peak (15,215 feet), is just over three miles above sea-level; it was first climbed in 1786 by two Frenchmen, and the next year a third Frenchman reached the summit, taking with him eighteen guides. The way to the top is now well known, and parties ascend every year.

The Jungfrau, another of the great mountains of Switzerland,

MOUNT EVEREST, THE HIGHEST POINT ON EARTH (29,002 FEET).

Until 1921 no European had set foot on the upper slopes of this monarch of the Himalayas. Then a small party, after great difficulties, ascended to within 6,000 feet of the summit. In 1922 the attempt was renewed, and a height of 27,300 feet was reached. In 1924 another attempt was made, and two of the gallant climbers, Messrs. Mallory and Irvine, were seen at a height of 28,227 feet, less than 800 feet from the top. As they never returned, it is impossible to say whether they actually reached the summit, but it is believed they did.

is famous for the view from the top at sunrise; the mountain used to be considered very difficult and dangerous to climb, but there is now a railway up the slopes for those who do not care for the difficulties of mountaineering. A third great height, the Matterhorn, was one of the last Alpine peaks to be ascended. In 1865 a party of four Englishmen took three guides and set out, reaching the summit in safety, but in the descent four of the party, three of the Englishmen and one of the guides, slipped and fell from a great height to the glacier beneath the mountain, all four losing their lives.

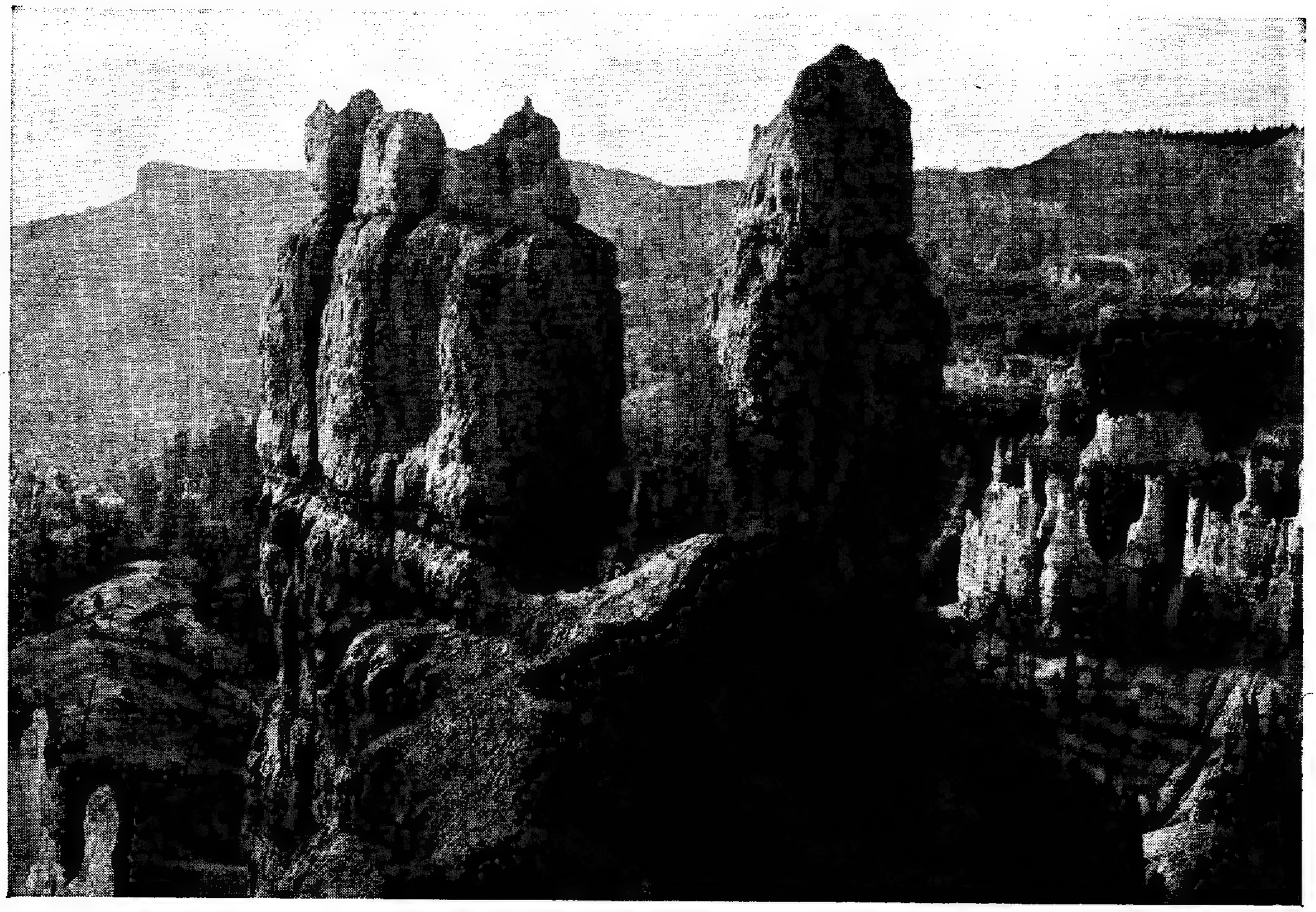
[*Fleet Agency.*

GLACIER POINT, YOSEMITE VALLEY.
Often described as the finest view-point on earth.

One of the most famous of the world's mountain-peaks, and one of the most beautiful and shapely, is Fujiyama in Japan, pictured in our Plate facing page 128. The name means "mountain of immortality," and Fuji is regarded as sacred by the Japanese, thousands of whom make pilgrimages to its summit every year. Fuji is an almost solitary peak rising out of the plain about sixty miles south-west of Tokio, the Japanese capital; it is not part of a great range, as are Everest and Mont Blanc, and thus looks higher because of the comparatively flat country round it.

The Japanese have many legends about the origin of this mountain;

one is that it rose steaming from the sea, and another tells how it descended from the sky to the plain. Yet another, which is nearer to the truth, is to the effect that one night, in the year 286 B.C. (or, as the Japanese put it, 376 years after the founding of their empire), the people of the plain were roused from sleep by roaring noises which lasted all night. In the morning they saw that all the high mountains surrounding the plain had disappeared, and one solitary peak, Fuji-yama, had risen quite suddenly, towering higher than any other mountain in the whole country. The new mountain spat out fire and



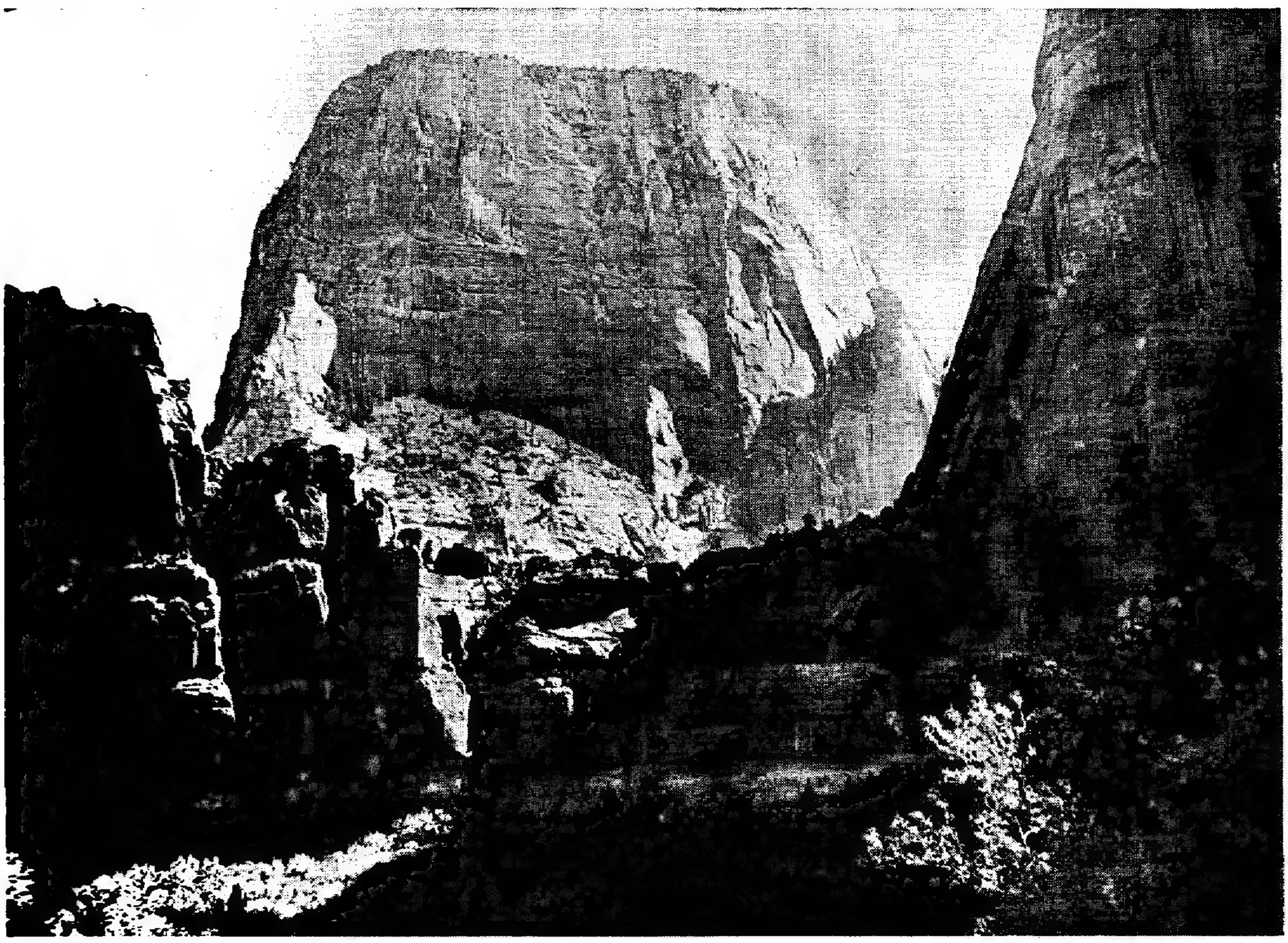
[*H. J. Shepstone.*

WEATHER-WORN "SENTINEL" ROCKS IN BRYCE CANYON, UTAH.

stones from its summit, and how long this lasted nobody can now say, though it has occurred again and again since.

The truth of the matter is that Fuji stands in the volcanic region of Japan, and what happened was that a series of eruptions, probably accompanied by an earthquake, blew a new crater or vent in the ground, and this, as the eruption proceeded, built up round itself a cone of volcanic rock and ash, which is now the mountain. At first, of course, the cone was only a small one, but successive eruptions made it bigger and higher, until it reached its present size. Fuji

now has a cone 12,370 feet high and over twenty miles in diameter at its base. The lip, or edge, of the crater rises to a number of small peaks, like the tips of flower petals, and for ten months of the year the whole summit is covered with snow, during which it is one of the most beautiful peaks in the world. Fuji has been in eruption only fifteen times in the last two thousand years, but some of these eruptions have been very violent. The last eruption, so recently as the summer of 1923, was perhaps the most terrible on record. Thousands of



[*Topical.*

THE WHITE ROCK, ZION CANYON, UTAH.

El Gobenador, a huge white rock, rises 3,000 feet sheer from the floor of the Canyon. It is rendered more impressive by the fact that the adjoining rock walls are red.

people perished by earthquake, fire, and tidal wave, and large parts of Tokio and Yokohama were destroyed.

Similar isolated peaks in Africa, notably Kilima Njaro, have been climbed in recent years, and have proved to be extinct volcanoes. In South America, peaks nearly rivalling Everest in the Himalayas exist in the great range of the Andes, some of the highest being in Ecuador, almost on the line of the equator. Chimborazo, over 20,000 feet high, is situated on the equator, but its summit is always

snow-covered, and great glaciers descend from the ravines beneath its ice-clad extinct crater. Cotopaxi, nearly 20,000 feet high, is still an active volcano, and is second only to Fujiyama in beauty.

With the exception of Everest and a few of its giant Himalayan brothers, practically all the great mountains of the world have been climbed by man during the last two centuries, though before that time, it seems, few people thought it worth while to take the risk. But in recent years adventurous spirits have conquered the great heights of every continent, penetrating even to the mysterious heart of Africa and the forbidden wastes of Central Asia. There yet remains another and perhaps more dangerous quest, the exploration of the great caverns that in many parts of the world—especially in limestone regions—penetrate the mountains themselves. Many of the caves have been partly explored, but who knows what secrets lie beyond? Certain it is that beneath the earth there are thousands of stately halls, glistening with beautiful crystals, that no mortal eye has ever seen.

E. CHARLES VIVIAN.

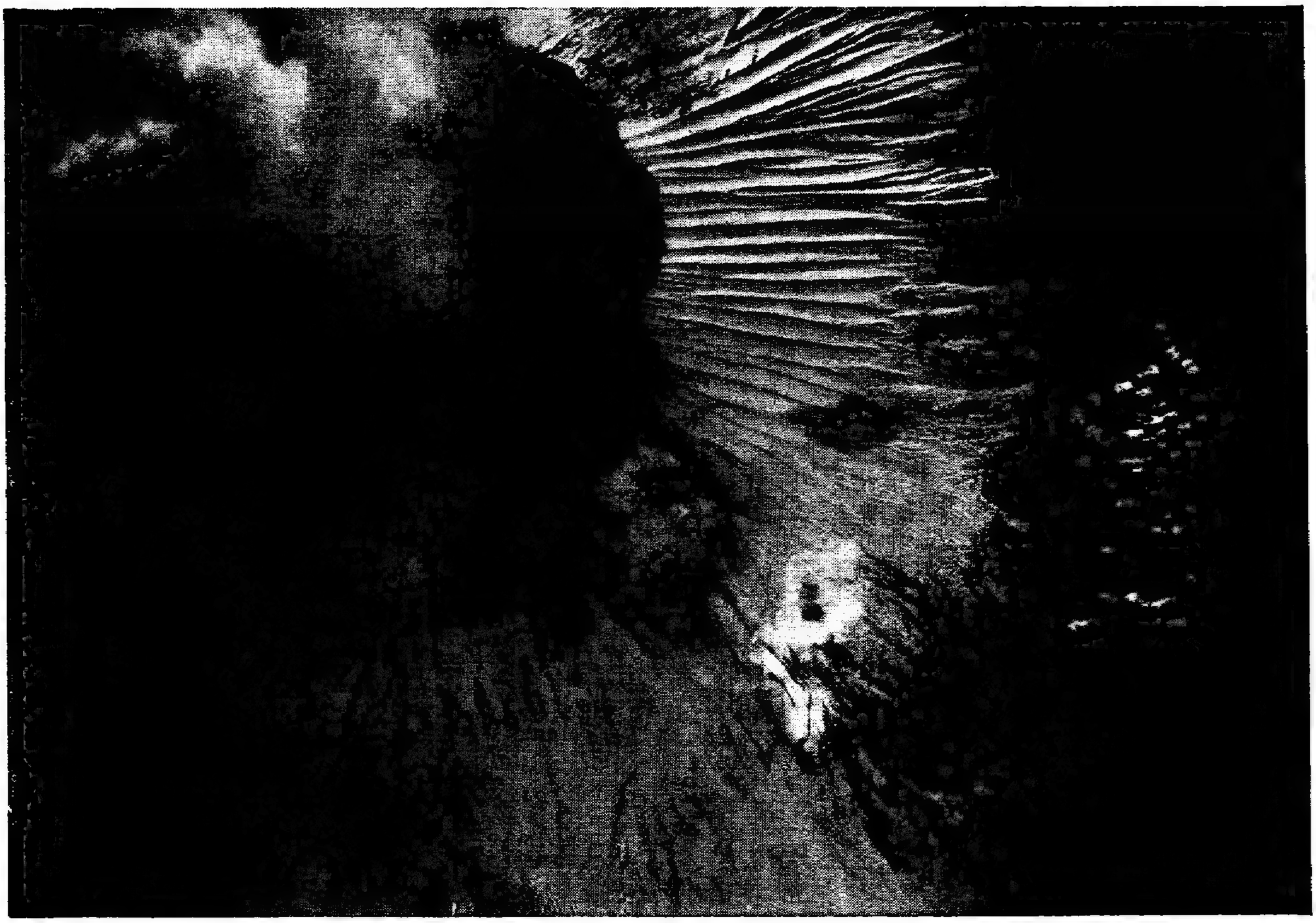
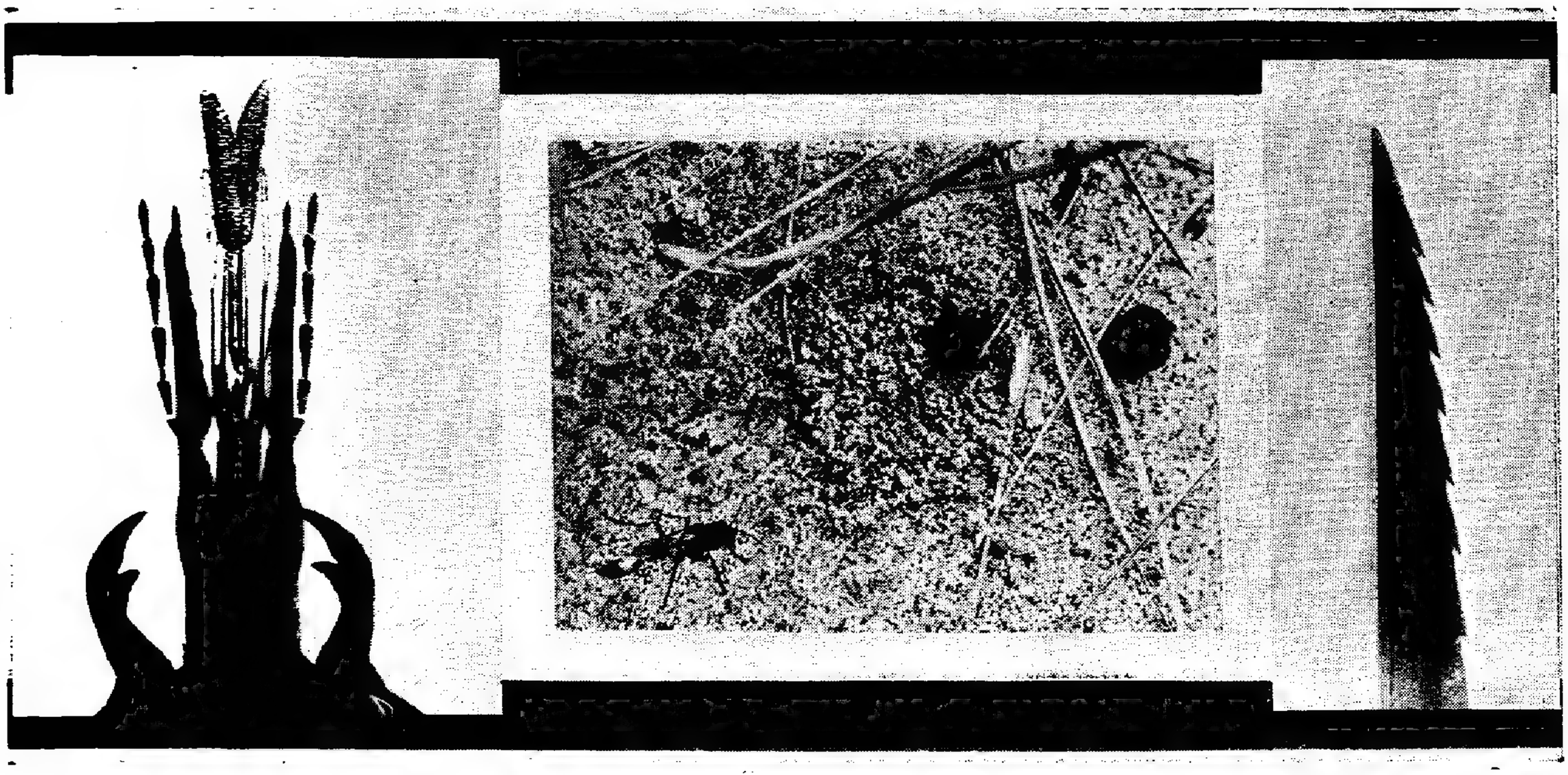


Photo by] *[Alan J. Cobham.*

THE CRATER OF VESUVIUS.

A wonderful view taken from an aeroplane. On entering the sulphurous atmosphere the machine suddenly "jumped" 1,000 feet.



[*Photographs by John J. Ward, F.E.S.*

Mouth parts of Sand-Wasp, showing the pair of strong jaws, the curious tongue, and mouth feelers.

A Female Sand-Wasp going to her burrow, which she excavates with her mandibles and legs.

Barbed tip of one of the darts in the Wasp's sting.

The Wonderful Tools of Insects

MOST boys and girls, unless they are exceptionally lucky, have been at some time stung or bitten by an insect. The pain is much the same in either case, and probably you haven't stopped to inquire what really happened. All you have been anxious about is that it shouldn't happen again. Yet the "tools" which give the insect its power to annoy or harm are really very wonderful, and worth a little study.

First, it is as well to remember that the two modes of attack are very different, for to bite means the application of the mouth-parts, to sting, those of the tail-end.

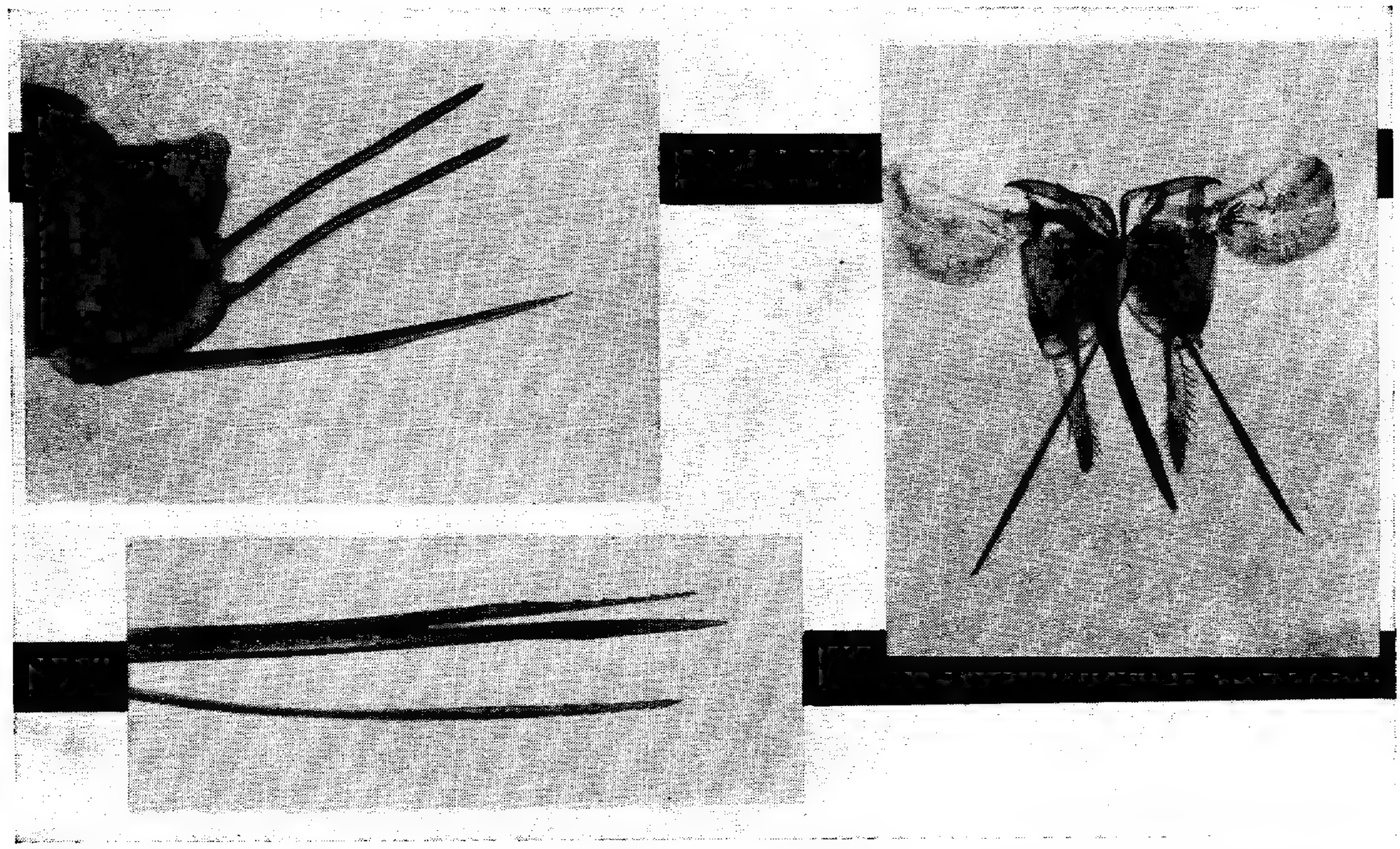
When considering biting insects, we must not think of them as having mouths and teeth like our own. The jaws of insects which bite work sideways, like the blades of a pair of scissors, not from above and below, like our own or those of most animals.

The whole mouth-parts of an insect are, indeed, very wonderful. Besides the strong biting mandibles, there is a second pair of more complex jaws, often provided with sensitive feelers, which also work from side to side. Above these two pairs of jaws is a kind of upper lip, and beneath them a lower lip, which bears still another pair of

feelers ; so that, actually, the mouth-organs of a typical biting insect, like a beetle, consist of six parts.

Although these six parts may be regarded as a typical arrangement, they have, in each species, been modified to meet particular requirements. To put the matter in another way, the mouth of an insect is its tool-box, and the tools are specially adapted to the particular work the insect has to do.

Few insects actually bite man. Insects which can pierce our skin, such as the gadfly, the mosquito, the flea and others, probe the flesh with very minute surgical instruments of remarkable strength,



[*Photographs by John J. Ward, F.E.S.*

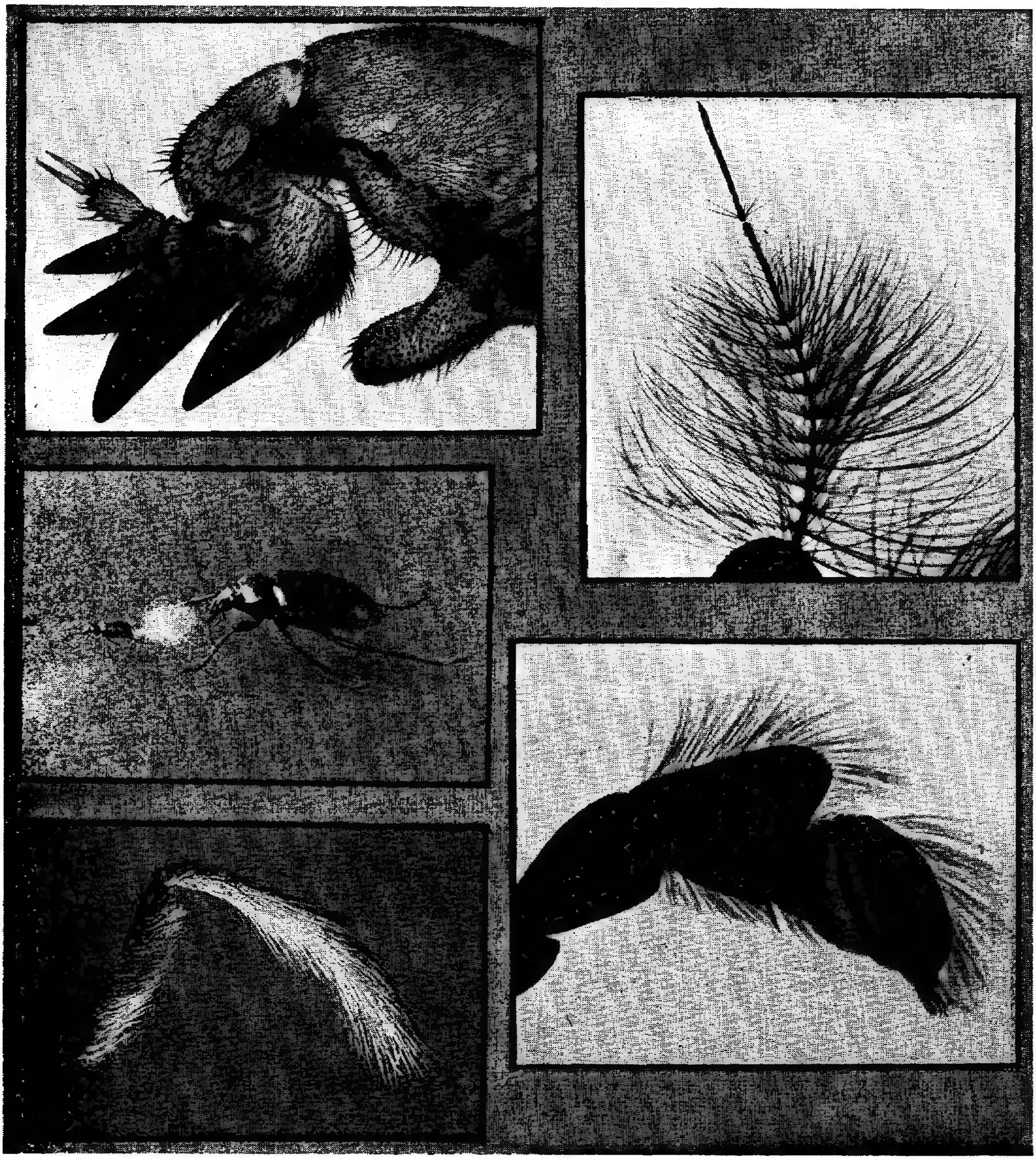
1. Tail-end of an Ichneumon Fly, showing the long and sharp egg-depositor, which pierces the bodies of caterpillar victims.

2. The egg-depositor more highly magnified to show its piercing parts.

3. The stinging parts of a Wasp. The dark central object is the sheath, which carries the two barbed darts seen at each side, connected with two poison bags.

and these set up a flow of blood which the insects suck up. Fortunately, however, the fearsome tools which insects carry are not specially directed against man.

Amongst our photographs is one showing a sand-wasp going to its burrow, and another illustrating the mouth-parts of the same insect as they appear under the microscope. What a wonderful mouth it is ! Note the large pair of strong, toothed mandibles. Their function is not to bite, but to excavate the sand when the wasp is



[*Photographs by Harold Bastin* (3 & 5) *and* (1. 2 & 4) *J. J. Ward, F.E.S.*

1. A Mole-cricket's foreleg, showing blades used for digging, and small forceps : the oval opening in the "knee" is one of the ears.

2. One of the antennæ, or feelers, by which a male gnat or mosquito hears the humming sound of the female insect.

3. Bombardier Beetle discharging a puff of acid vapour at an enemy who is chasing it.

4. Leg of Whirligig Beetle, showing expanding plates of foot and flattened joints of leg for aquatic locomotion.

5. Foreleg—dusting-brush foot—of Red Admiral Butterfly.

[J. J. Ward.

Profile portrait of a large white Butterfly, showing one of its eyes and the long tongue partly unrolled.

making its tunnel; the loose sand is carried out mouthful after mouthful, the wasp backing out each time.

When the burrow has been formed, its mouth is closed with a stone of suitable size. The wasp then goes in search of a caterpillar. Presently it finds its quarry, and, quivering with excitement, boldly attacks the caterpillar with its large jaws, not to bite, or to kill, but merely to control it while, with the skill of an experienced surgeon, it stings the caterpillar at a particular nerve centre which causes paralysis. The caterpillar is then under "chloroform," as it were, and the next business is to get it back to the burrow.

Again the strong jaws come into use, for the wasp takes a good grip of the helpless victim, which is larger than herself, and getting her legs on each side, proceeds to drag her burden home. She has a long way to go, but eventually arrives at the burrow, and having removed the covering stone, she manipulates her prey with her jaws; coiling it up and packing it neatly at the bottom of $2\frac{1}{2}$ inches of boring, her tongue and mouth-parts pressing and moulding the walls of the burrow, and probably secreting substances to prevent the sand from falling in.

On the body of the caterpillar Mrs. Wasp lays an egg. Afterwards she places in the burrow another caterpillar, and then the hole is closed with sand. In this way she provides the offspring destined to hatch from her egg with fresh meat.

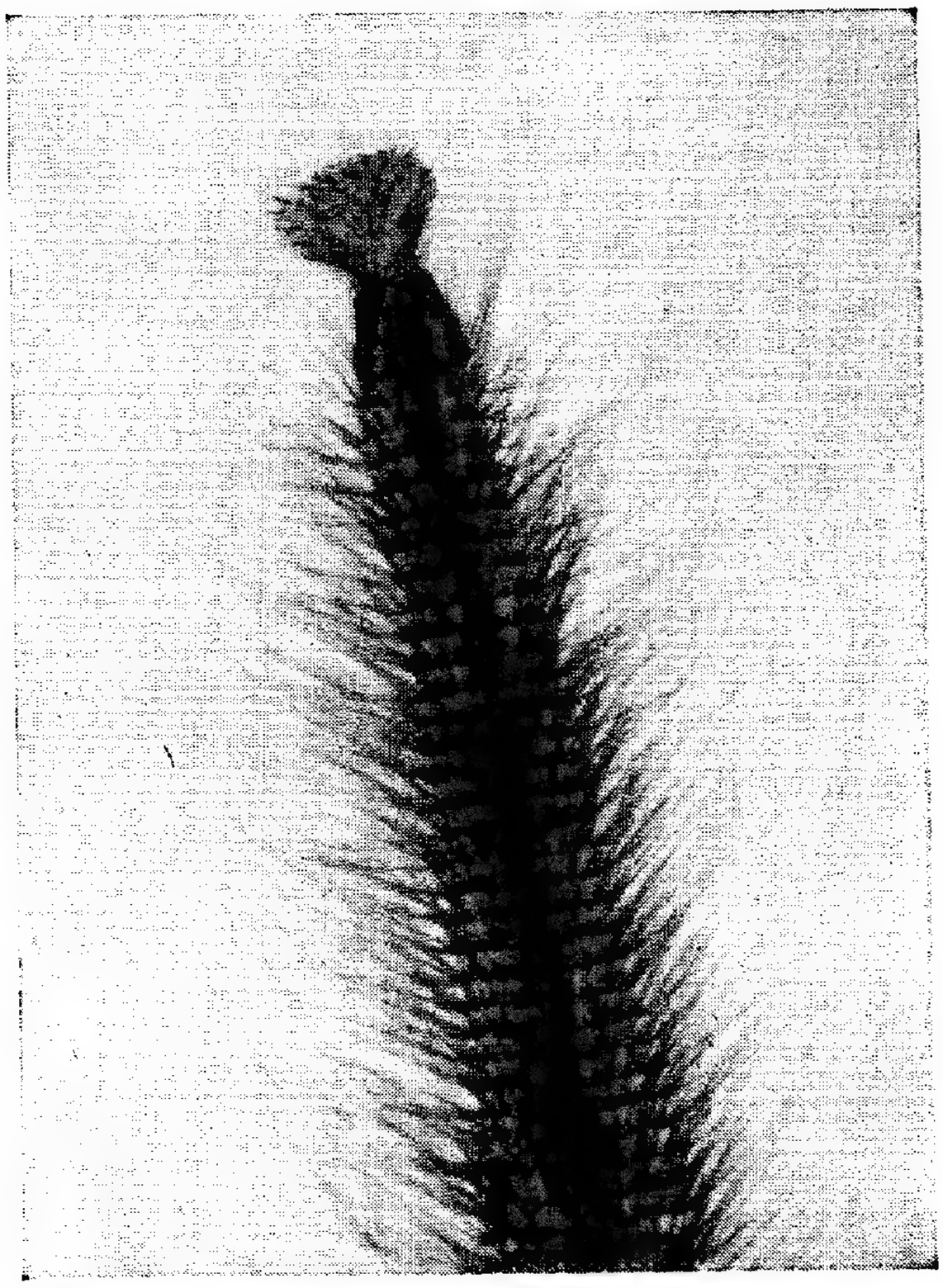
The mouth of the honey-bee is equally wonderful, being furnished with shear-like blades for moulding and cutting the waxen cells of the comb. Its tongue is much longer

[J. J. Ward.

Tongue, or proboscis, of Butterfly, which is unrolled to suck up nectar from the depths of flowers.

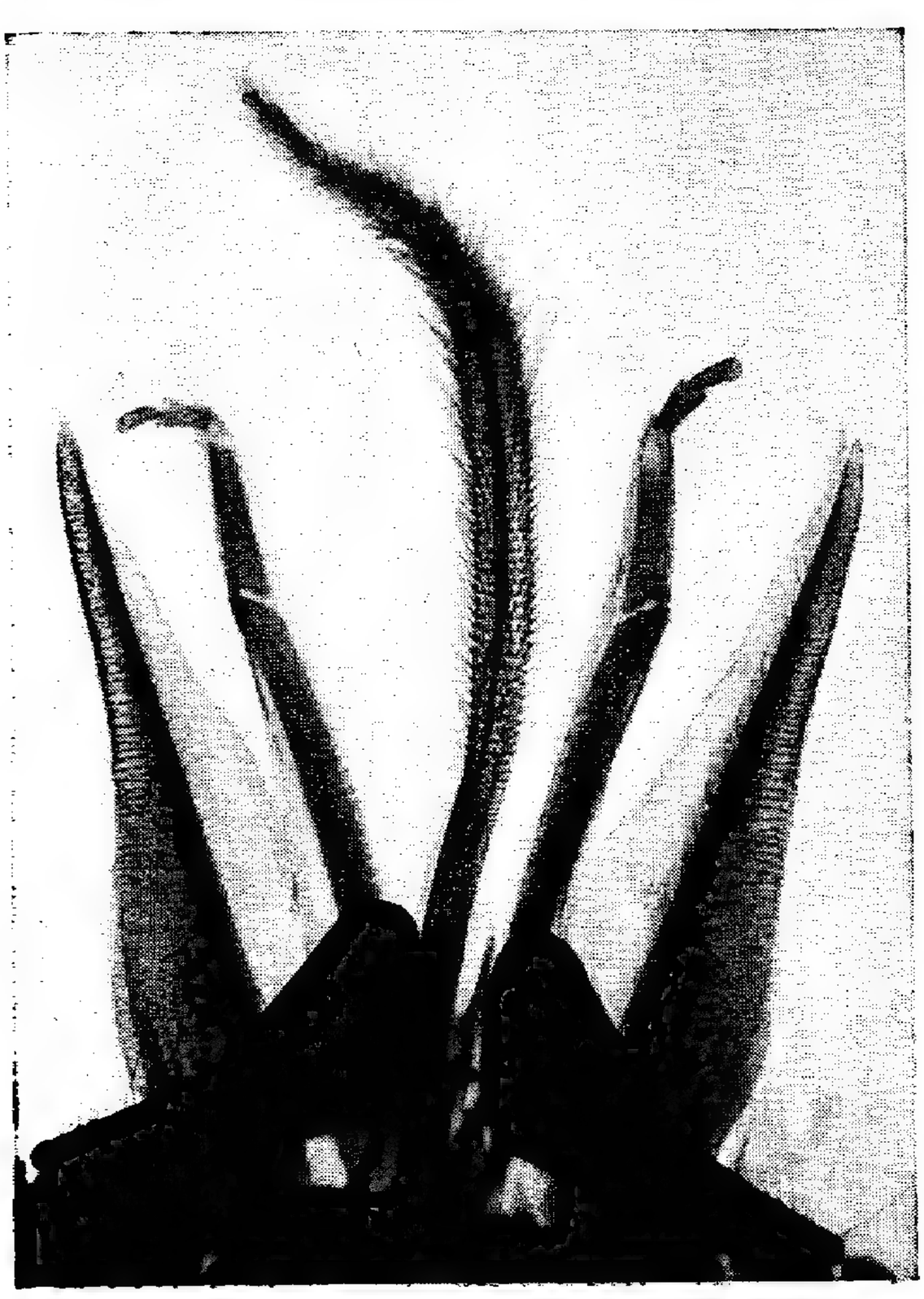
than that of the sand-wasp, because it has to suck nectar from deep flower tubes which are never visited by the wasp. The long tongue, or proboscis, is, indeed, a most complicated suction pump, with a spoon-like tip, beautifully contrived for gathering the sweet fluids from flowers.

Ants are provided with strong biting jaws and often attack caterpillars very many times larger than themselves, dragging them back to their nests. The larva of the palisade saw-fly, when feeding, adopts a very curious device to prevent such attacks. It builds around its feeding area



[*J. J. Ward.*

Tip of Honey-Bee's tongue. With this the bee probes the depths of flowers for their sweet nectar. Note the spoon-like tip.



[*J. J. Ward.*

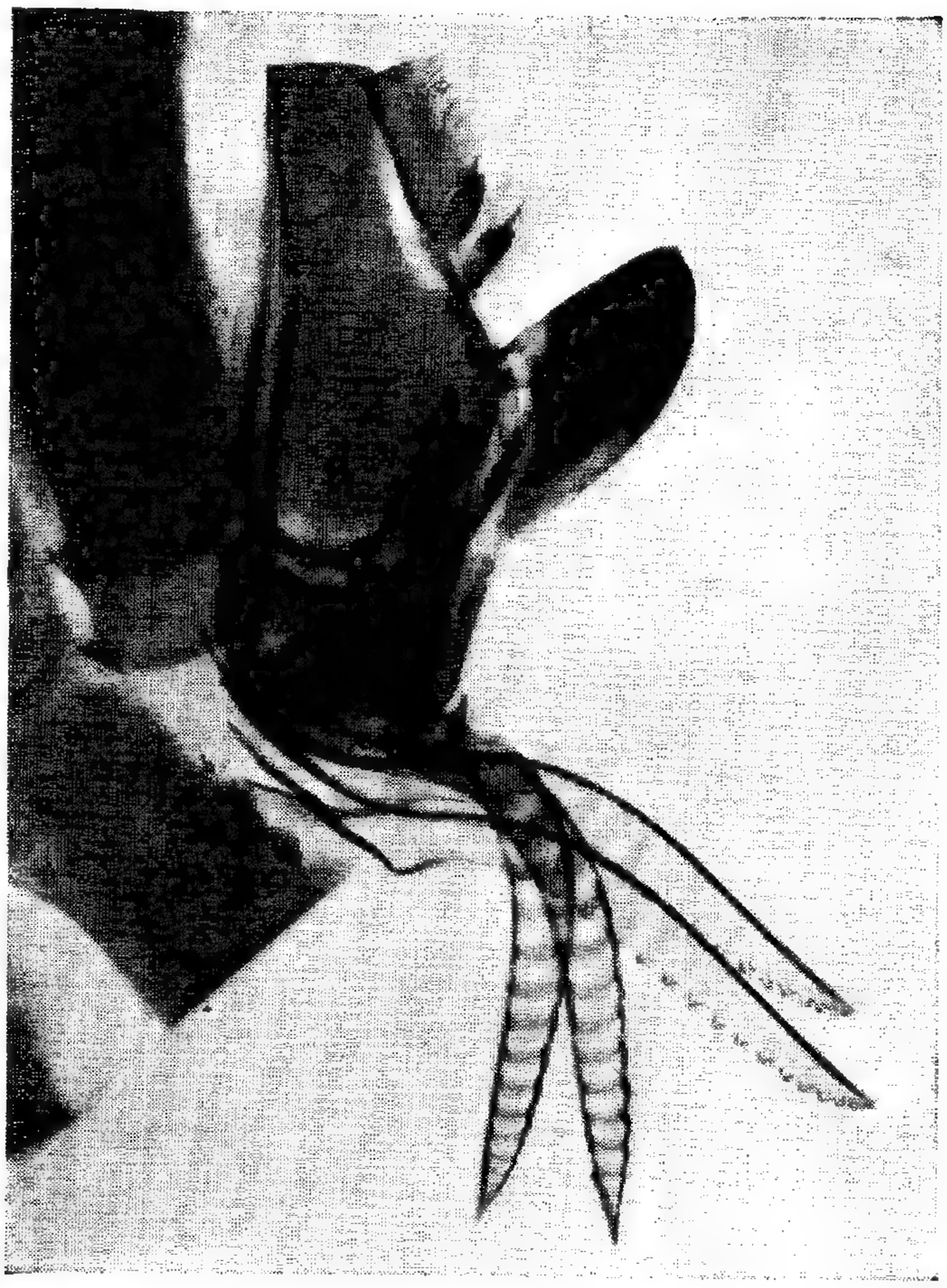
Mouth-parts of a Honey-Bee, showing the long hairy tongue and the shear-like blades used for moulding and cutting wax when making cells.

a series of saliva palisades, like those shown in the photograph, and, as the saliva is of a pungent nature and very disagreeable to the ant, the caterpillar remains unmolested. Should an inquisitive ant come up to investigate these sticky palisades, and touch one, it at once becomes "gassed."

Saw-flies are wasp-like insects which carry at their tail-ends a pair of tiny and marvellously-constructed saws, together with a pair of hairy feelers to direct their use. The saws are used for cutting a slit in the tissues of stems and leaf veins, in which the fly places its egg.

Ichneumon flies belong to another class of insects which carry tools at their tail-end, but, instead of saws, they have three sharp-pointed instruments which, collectively, are used for piercing the bodies of caterpillars and placing an egg at the wounded part. The little ichneumon fly grub then hatches out and finds it has a caterpillar on which to feed.

The ichneumon fly's egg-depositor is a kind of sting, somewhat like that of the common



[*J. J. Ward.*

The tail-end of a Saw-fly, showing its pair of saws with their covering sheaths.

[*J. J. Ward.*

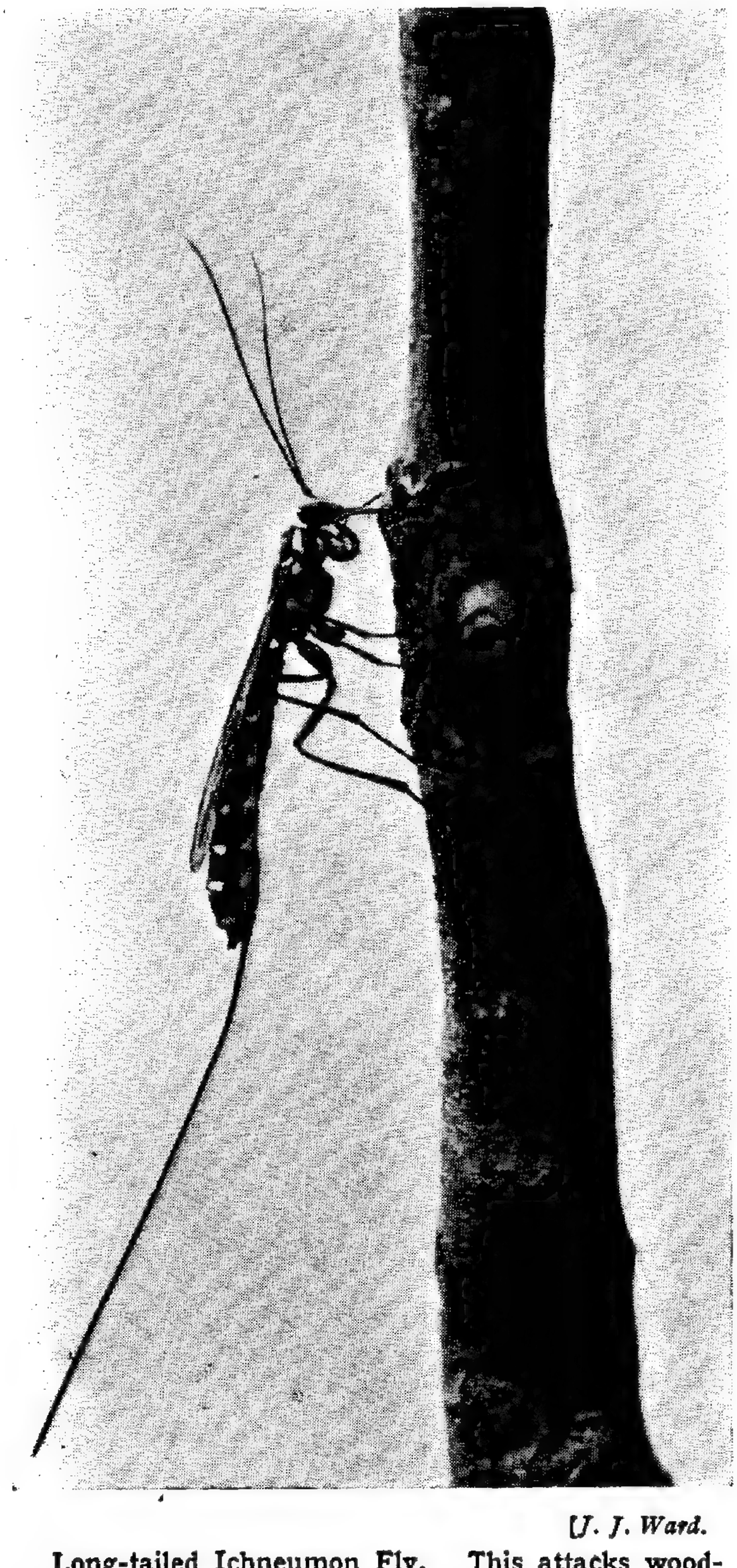
The wonderful palisades the larva of the Palisade Saw-fly erects round its feeding area so that enemies cannot approach.

worker wasp, with which we are all only too familiar, but the sting of the wasp is really an egg-depositor which has been modified into a weapon of defence, only the queen wasp using it for its legitimate purpose, that is, to lay eggs, and the queen wasp rarely stings.

The black, sting-like object we see the wasp darting out at her tail-end is really the sheath, or director ; the stings themselves consist of two three-sided, needle-like darts with barbed tips which work in grooves in the director. When the sheath has made the wound, these darts move up and

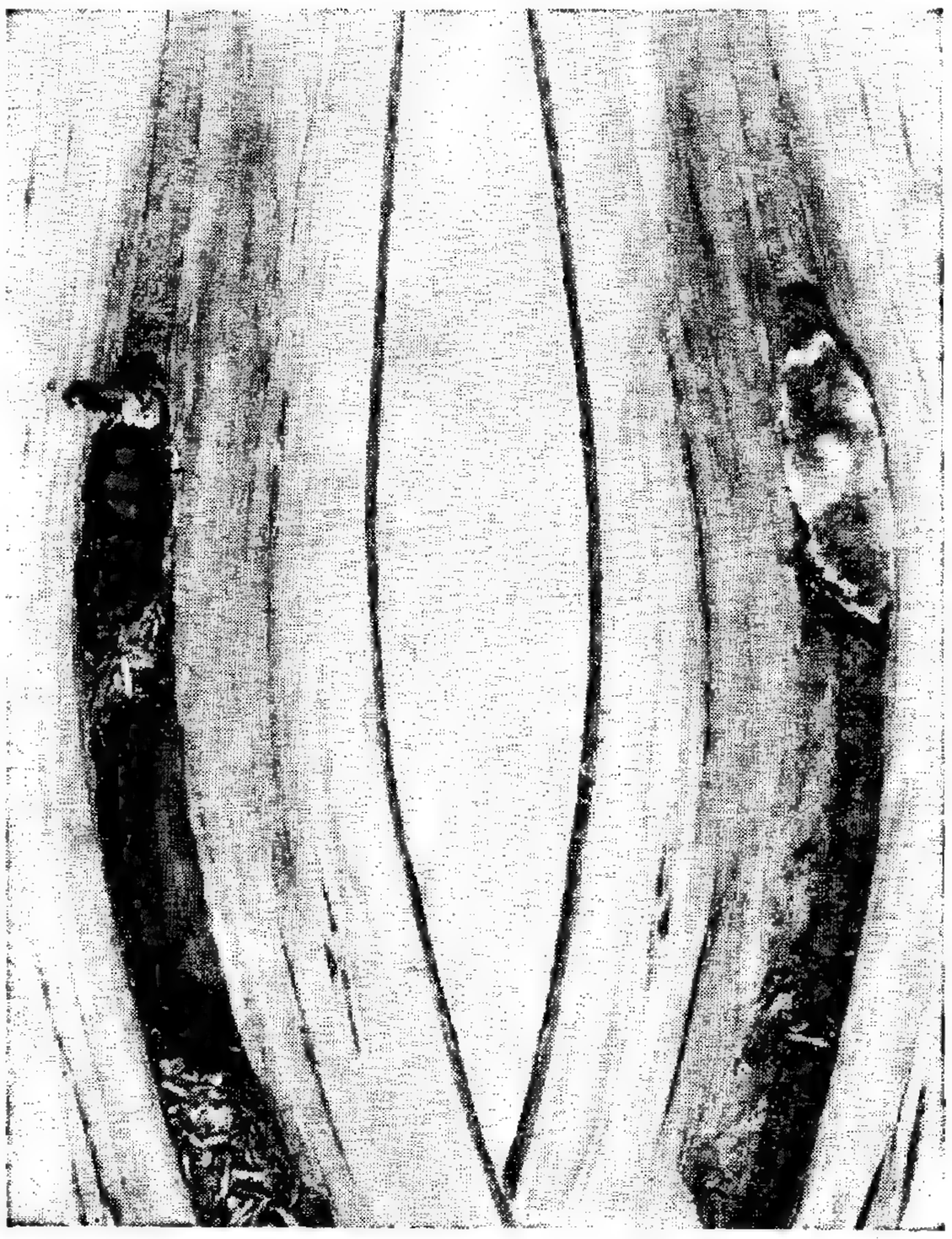
down, and formic acid is pumped from the poison bags into the puncture.

Fortunately, there are many insects which neither bite nor sting, but their working tools are very different. The mouth-parts of butterflies and moths are composed of a pair of long, coiled tubes grooved on their inner sides



[J. J. Ward.

Long-tailed Ichneumon Fly. This attacks wood-boring grubs. It uses its long sting-like organ (which is really an egg-tube) to search the burrows where the grubs are feeding, and is thus enabled to deposit its eggs in their bodies.



[J. J. Ward.

Branch of the Goat Willow Tree split down to show chrysalis of the Lunar Hornet Moth. The mass of wood-chippings at the base on the left block up the entrance hole until the moth is ready to leave the branch.

to form a third tube when united, and it is through this third tube that the butterfly takes up the nectar from the flowers, unrolling its long trunk and probing their depths. The combined tubes are no thicker than a horse-hair, and the insect can separate, clean, and unite them at its will; so complex and wonderful are Nature's tiny tool-bags.

JOHN J. WARD, F.E.S.

[*Topical.*

A PRACTICE FLIGHT.

The Wonders of Bird Migration

OF the many wonders of this wonderful world none is more amazing than the tremendous length and difficulty of the journeys undertaken by birds. We are often astonished to read in the newspapers of some great flying exploit by an airman, but think what flights the birds have made for thousands of years! In the summer it is amusing to watch the swifts darting and circling against the blue sky, but we know their stay is but short and that in a few weeks those very birds will quite likely be in Cape Town, between five and six thousand miles away. Only the other day I had a letter from a friend in South Africa who said that a man had captured a swift bearing a small aluminium ring round one of its legs, and the markings on the ring indicated that the swift had first been caught in Essex. After being fitted with the ring, so light that it could not hamper movement at all, the swift had been released, to wing its way to the sunny south.

Only within the last few years have migratory birds been traced in this manner. For a long while it was known that, at certain seasons, great movements of birds took place. In our winter there are no swallows and swifts in Northern Europe, but the birds appear in large numbers in regions nearer to the Equator. Then lighthouse keepers had noted the passing of large numbers of birds of many kinds, especially at night, when a scene such as that represented in our coloured *Frontispiece* is by no means uncommon. Seebohm records that 15,000 skylarks have been caught on Heligoland in one night. But just how far any particular bird might travel was a mystery until a definite scheme of marking was carried out.

WONDERS OF BIRD MIGRATION

Under the direction of the University of Aberdeen, some seven thousand nestling swallows were one year marked with numbered aluminium rings. Out of this large number only sixty were reported, but these cases indicated quite clearly the extent of the journeys taken by the birds. Of two swallows bearing the Lancashire mark one was found in the Isle of Wight in October, the other in Central France in the same month. Two young swallows ringed in Staffordshire were discovered in France in the late autumn. Evidently these migrants were on the way to regions farther south. A swallow marked in Stirlingshire was captured in the Transvaal in the following January, whilst another bird from Ayrshire was reported from the Orange Free State in March. So there is no doubt that the birds really do cover immense distances during their migratory flights.

The distance traversed by the swifts and swallows is not by any means the greatest. The Arctic tern literally goes from pole to pole. The distance between the two farthest points at which this bird has been observed is no less than *eleven thousand miles*! This remarkable bird certainly secures more daylight than any other living creature on the face of the earth. It turns up in the northern polar regions when summer is beginning, at which time the sun never dips below the horizon; then, at the approach of autumn, away the bird flies to the Antarctic, where it arrives just in time for the continuous daylight of the southern summer. It has been computed that this bird must enjoy twenty-four hours of light daily for nearly eight months in the year.

[*Illustrations Bureau.*

SOUTHWARD BOUND.

Migrating birds photographed near Land's End.

Not a great deal is known as to the routes which migrating birds follow. Probably the flocks keep in touch with land as much as they can, avoiding, where possible, long journeys across the sea. When the route is over the ocean it is often at points where the land was formerly linked. Thus from South-East England the birds pass to Europe over a part of the North Sea, where a comparatively small rise in the level would once more join Great Britain to the Continent.

A correspondent of one of the newspapers wrote describing how one spring morning he saw from his bedroom window a great streak of blackness, apparently a mile long, come across the English Channel towards the Kent coast.

"Watching the black streak through my telescope," he wrote, "I saw how it moved, rose, and dipped with perfect grace. Suddenly it broadened out, and I found that it was composed of thousands upon thousands of birds. The whole sky seemed to be alive with them

"They came just over the land, swooped back out to sea for a little distance, still retaining their formation, and then returned and passed over the town inland in a north-westerly direction."

How fast do migrating birds travel? Here again it is not easy to give a definite answer. Some are very rapid travellers indeed. An observer who spent many years studying the subject states that a swallow can fly at the rate of ninety miles an hour, whilst the little Arctic bluethroat can nearly double this speed. In other words, this tiny creature flies at three times the speed of our fastest express trains. Generally speaking, migrating birds do not put forth their whole energy, for they have a long way to go and must conserve their strength. Probably the average speed of migrating birds, of whatever kind, does not exceed forty miles an hour. The flying will not be continuous, for a certain amount of time must be given to feeding and resting.

It is natural to ask why birds undertake these great journeys, which certainly mean a great deal of fatigue and often real peril. Large numbers perish from one cause or another before they reach the end of the journey, yet hardship and difficulty in no way deter the birds from pushing on. Beyond doubt, the chief reason for migration is the need for food. How could a swift live in England in the winter

A LESSON FROM THE BIRDS.

This wartime picture shows a shelled and ruined town which man is doing his best to destroy. The swallows, on their way to the Sunny South, calmly rest on the telegraph wires, undisturbed by the turmoil of battle and determined to " carry on " as usual. Nature's decrees are more potent than any of man's making.

when there are no gnats to eat ? So it flies to the sunny south, where insect life is abundant.

How do migratory birds find their way on their long journeys ? Our airmen have compasses and maps and direction signals, but the birds often fly so high that it is a marvel that even their keen sight can descry the land, especially during the night, when most of the flights

are apparently made. At present we can say no more than that inherited instinct seems to tell them when to start and which direction to take. But really that is no answer at all. Perhaps some thinking boy who reads this book will help us to solve the problem.

S. LEONARD BASTIN.

Under-water Salvage

The Wonderful Implements of the Modern Diver

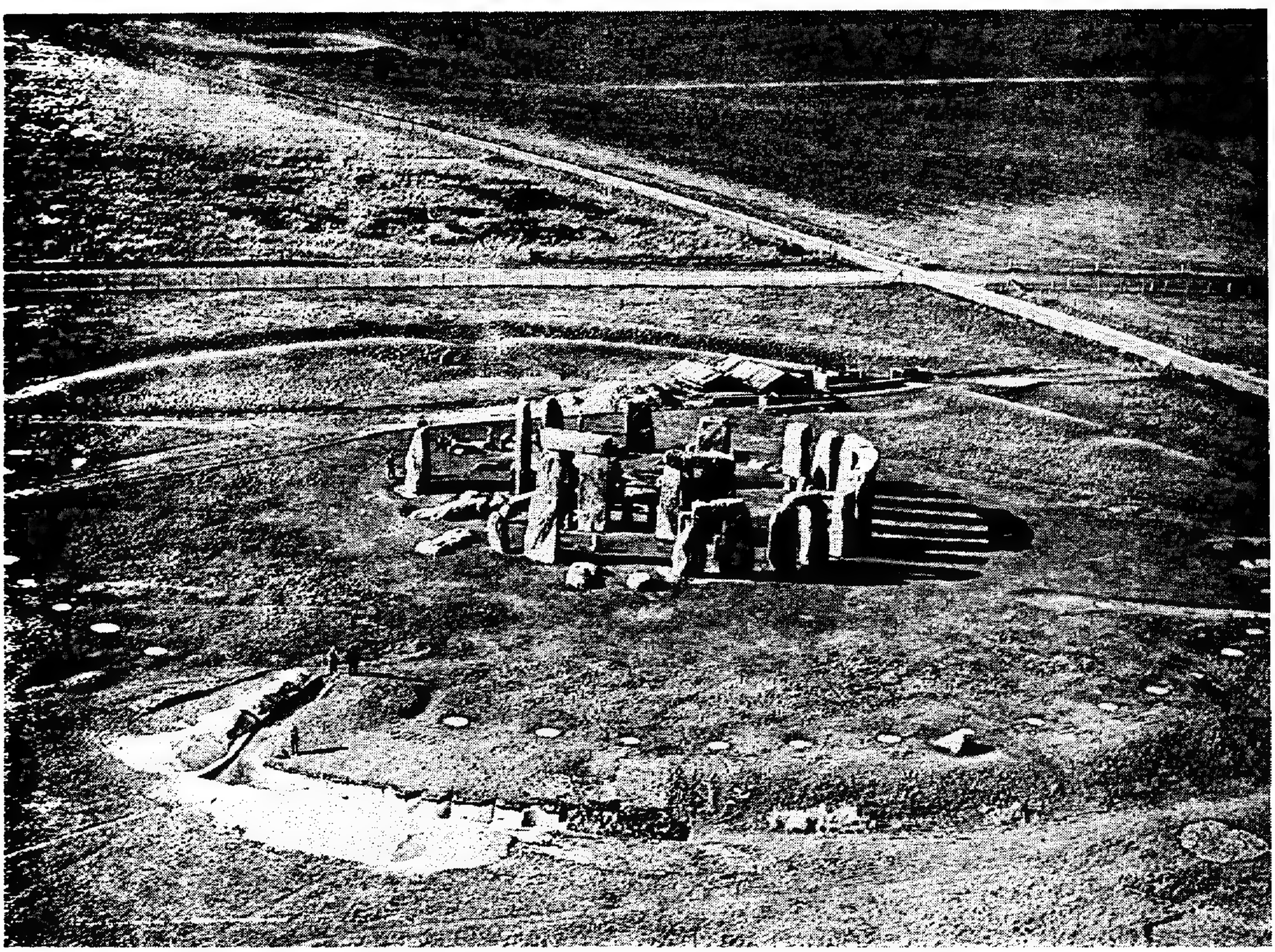
AS a consequence of the great amount of salvage work carried out during and immediately after the War, many new appliances have been devised to assist the diver in his work below the surface of the sea.

In the picture which forms the cover of this volume a diver is seen at work against the side of a sunken ship. In his hand is an oxy-acetylene torch, which works as freely under water as above; with this he is cutting away the jagged edges of the torn plates round the huge hole that has been torn in the side of the vessel. The heat generated by this powerful torch cuts away the steel plating as if it were cheese; when these jagged pieces of steel have been removed a timber patch will be placed over the gaping hole and the flooded hold pumped out, in the hope that the vessel will thereby be rendered sufficiently buoyant to rise to the surface. The diver is enabled to see his work by a powerful submarine searchlight, which can be used under water as easily as above. Thus, where formerly he had to work by the feeble rays of a hand-lamp and to grope about in almost total darkness, he now has an intensely bright light.

In the left foreground of the picture is a submarine photographic camera. Within the steel outer casing is a large camera, which can be focused from the outside. The lens at the top and those to right and left are provided with powerful electric lamps, which illuminate the object to be photographed. The centre lens is for the camera. The shutter is operated by the diver. On top of the camera is seen a special type of view-finder. By means of this camera very clear photographs may be taken under water of the damage done to the ship, so that those directing the work may obtain an accurate idea of what is to be undertaken and make their plans accordingly.

Wonder-workers of Long Ago

THE life of a nation is very much like the life of a man—but with a difference. Just as one of two boys may go through youth and manhood growing wiser and wiser and be still learning when death comes, while the other may be almost as ignorant at eighty as he was at eight, so one country may keep on increasing in knowledge and cleverness, while another which has lived just as long,



[*Central Aerophoto Co., Ltd.*

STONEHENGE SEEN FROM AN AEROPLANE.

Viewed in this way, the ancient stone circle, now in course of restoration, is remarkably well defined. It is probably from 3,500 to 4,000 years old. The larger stones weigh as much as forty tons each. The surrounding mound and ditch are also clearly indicated. There was probably at one time an outer circle of stones.

or much longer, is far behind it in the arts and sciences which go to make up what we call "civilization." But, because some nations last fifty times as long as most men, we find now and again in their histories what is uncommon in the lives of men, namely, rapid progress up to a point, then an equally quick decline, sometimes without recovery and sometimes a more or less complete return to former greatness.

[By courtesy of Messrs. Fred Boissonas et Cie, Geneva.

AN ANCIENT WONDER LAID BARE : THE STOREROOM CORRIDOR OF THE FAMOUS LABYRINTH OF MINOS, IN CRETE.

Every schoolboy has read the story of the terrible Minotaur who lived in the Labyrinth until slain by Theseus. Each year the Athenians had to send to Crete a tribute of seven youths and as many maidens to serve as food for the monster. The story is fabulous, but recent excavations have proved that the Labyrinth, or maze, was very real indeed. The huge clay jars were used for storing oil and grain. What is known as the Minoan age of early Greek civilization extended over thousands of years.

It may be said that this corresponds with the long illnesses which befall men, but it is really different if you come to look into it closely.

Take the cases of Egypt and China. These were civilized up to a point thousands of years before the recorded history of Great Britain began, but in large parts of both countries the people are to-day little more than savages. These nations did not fall sick, but one fell gradually asleep, and the other stopped growing, and when nations do either of these things for a number of centuries on end their history becomes a little difficult to follow. Fortunately, it is almost impossible for any sort of civilization to exist for a fairly long period without leaving traces, and from buildings and vessels, pots, jars, and the like, which have come down to us from prehistoric times, we can often get a glimpse showing us how people lived all those thousands of years ago. And a very eye-opening and mind-opening glimpse it is.

[*Underwood & Underwood.*

Digging down to the ruins of ancient Babylon, the city of Nebuchadnezzar, 40 feet below the surface.

Nearly 4,000 years before Christ the Egyptians had a knowledge of arithmetic, astronomy and medicine, a system of writing, and great cleverness in building. They even had glass, though it was not transparent. Pictures of a somewhat later date show Egyptian glass-blowers at work, and among the very earliest relics of old Egypt are representations of musical instruments, notably the harp and the flute. The ancient Egyptians were, as we should say, civilized in many other ways, but most of their civilization was in the direction of getting luxury and enjoyment out of life, and, while the rich and noble fared well and often sumptuously, the poor derived little or no advantage from the knowledge their betters possessed. That is one great difference between ancient and modern civilizations. There is still to-day a big distinction between being very rich and being very

[*E.N.A.*

THE MYSTERY STATUES OF EASTER ISLAND.

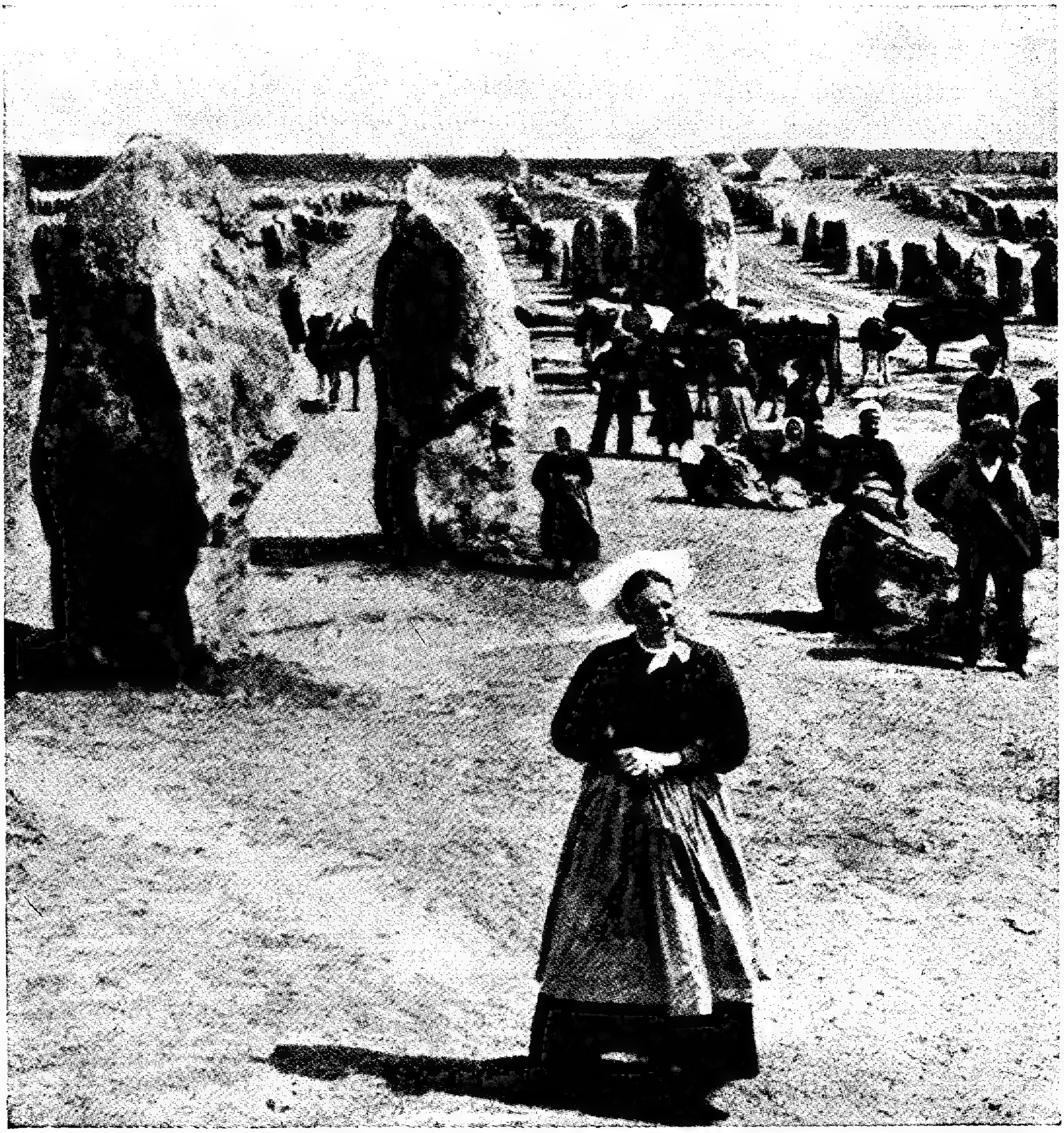
On the slopes of Easter Island are a great number of these roughly-hewn statues, or busts, some only just begun, others completed but sunk deep in the ground till only the head shows. Who formed them and what purpose they served is a mystery.

poor, but in the early history of mankind the poor were not only the slaves of the rich but often lived almost savage lives. Even the poorest in a really civilized modern country enjoys many advantages on exactly the same footing as a millionaire.

In ancient Egypt, as will be seen from another article, civilization showed itself most plainly in the erection of wonderful buildings. The Egyptian Pyramids, Sphinxes, and Temples, some of which we illustrate, are pre-eminent among the architectural and monumental wonders of the world. But of greater importance to the peoples who came after was the discovery and development by the early Egyptians of the art of making paper out of the Nile papyrus. On papyrus they both wrote books and painted astonishing pictures, many of which not only reveal their religious beliefs but give most graphic descriptions of their daily life and customs.

China's early civilization was different from that of Egypt, probably not so early and not so advanced, but still very remarkable. The "dynasties," or successions of rulers of whom we have records in Egypt, go back to about 5,000 years before Christ, but the first historical Chinese Emperor is said to have reigned from 2852 to 2738 B.C. According to Chinese tradition, he was a supernatural being with a human head and body and a fish's tail, but he was a useful king, for he taught his people to hunt, fish, and keep flocks, and introduced musical instruments and sign-writing. Later, but very early, emperors

invented farm implements, discovered the medicinal properties of many plants, and put together a useful calendar. To the wife of the "Yellow Emperor," who flourished at least 2500 B.C., is attributed the development of the silkworm, with results of age-long and world-wide importance. There are no architectural relics of these very old times in China—for the famous Great Wall is of a later date—but the early development of the nation can be traced by ornaments



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STONE AVENUES, CARNAC, BRITTANY.

The unhewn stones, from 3 to 16 feet in height, stretch across the grey moor by thousands. They are probably of Celtic origin, but little is known of the purpose they served.

and inscriptions on sacrificial bronze vessels of immense antiquity, the existence of which shows that the art of metal-working was known in that strange country at a time when races now much more civilized than the bulk of the Chinese were content with implements and utensils of wood and stone. China, however, from one cause and another, stopped growing until only a few years ago, when she suddenly started a career of progress—perhaps a little too quickly—on modern lines.

But Egypt and China were not the only countries which had early civilizations. The old inhabitants of Mesopotamia were by no means savages, and probably learnt a good deal from the Egyptians who conquered them. Babylon in its time must have been a great centre of luxury and magnificence, and its "hanging" or terraced gardens were among the Seven Wonders of the ancient world.

In Europe there was a wonderful civilization long before Greece, as we know it from our histories, began to be a pattern to the world in matters of art and the love of beautiful things. In the island of Crete amazing relics have been discovered in recent years in connection with the excavation of the great Palace of Knossos, which show clearly that in Eastern Europe there was a civilization much older than that of Athens, and one capable of great achievements in the difficult art and craft of architecture.

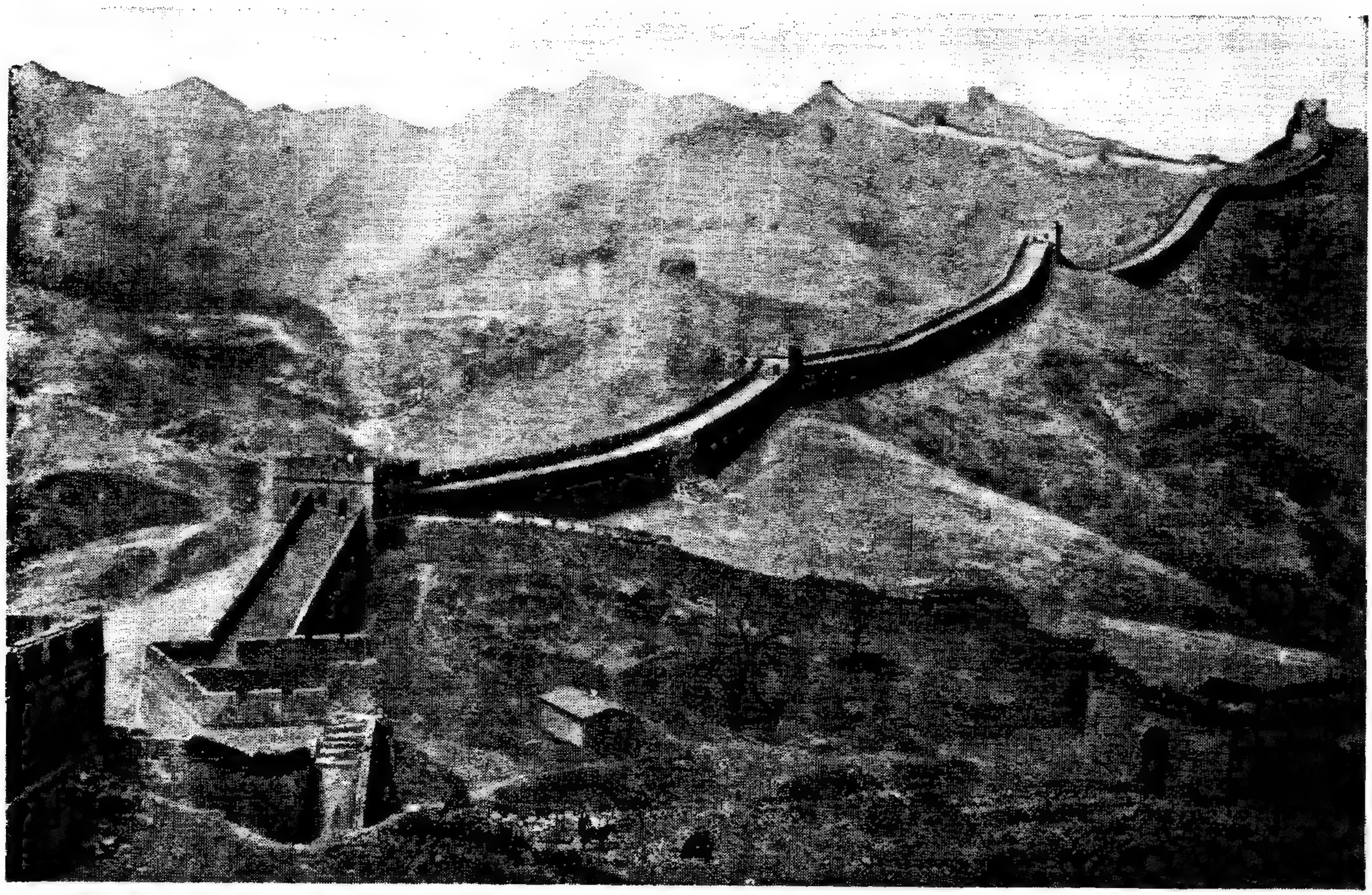
Most of these early civilizations, it has been said, had their rise in warm, well-watered lands, from the rich soil of which the people could get an easy livelihood, and so had time to think of arts and crafts. But it was necessary that the climate should not be too enervating, for that would have meant loss of the energy needed to design and direct great temples, tombs and other memorials, and to carry out the engineering and other works necessary for comfort and prosperity. It will be noted, too, that, partly perhaps because life was too easy for the governing classes, these early civilizations did not endure. Their very prosperity showed that here were countries which it was worth while to invade, and one after another these ancient Empires were either conquered or gradually decayed, because those at the head of them had lost the art of ruling. Still, many most interesting memorials of them remain, teaching us that ages ago there were men and women thinking and living very much as we do, and in many cases doing and producing things which we, with all our modern science and engineering skill, cannot excel, or even equal.

OWEN WHEELER.

[E.N.A.

THE TIEN-TAN, OR ALTAR OF THE TEMPLE OF HEAVEN, PEKIN

Here the Emperors in person offered prayers to Shang-ti, the Supreme God, on stated annual occasions and at times of drought or famine. On the central stone, which is a perfect circle, the Emperors knelt, "surrounded first by the circles of the terraces, and then by the circle of the horizon."



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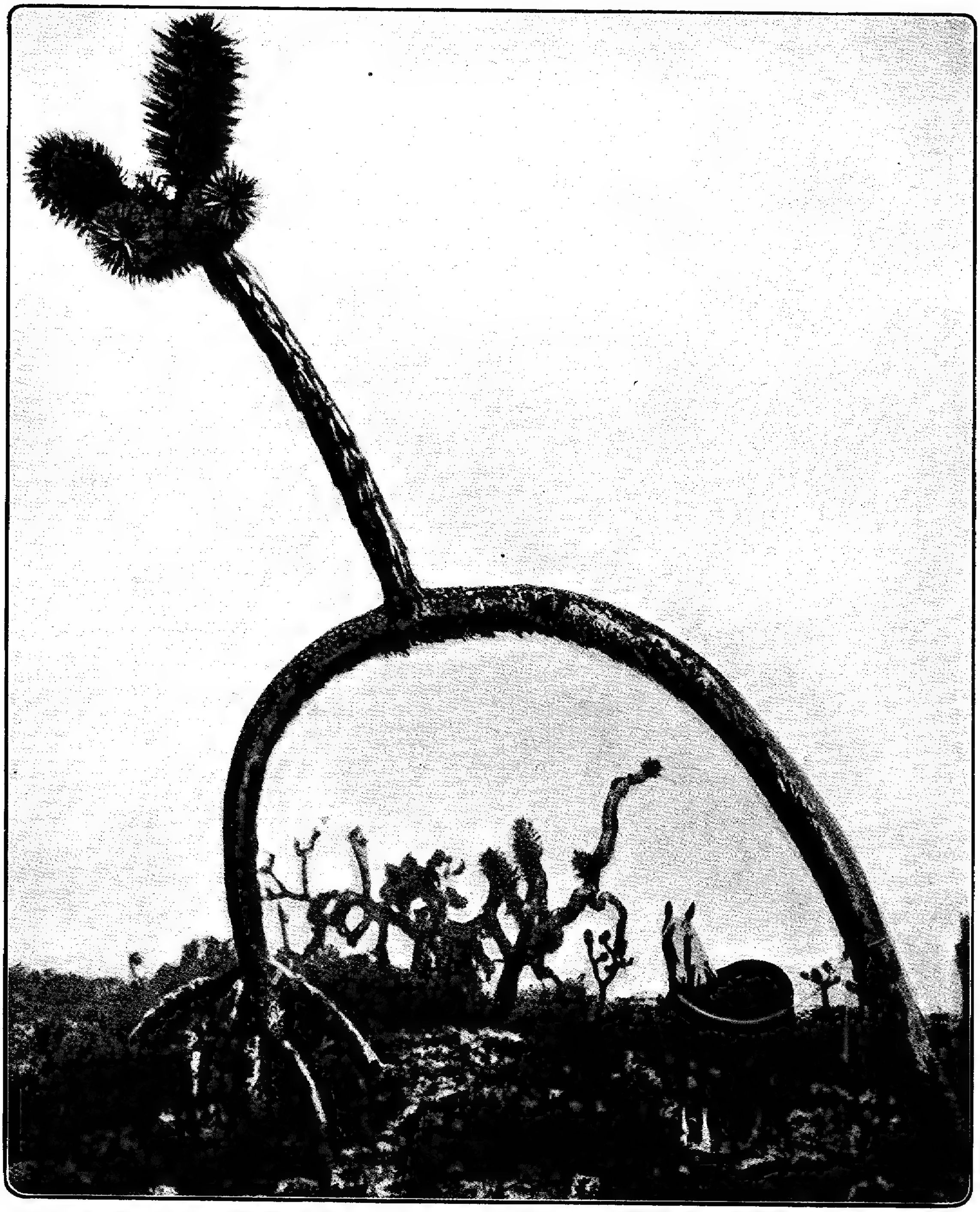
A SMALL SECTION OF THE GREAT WALL OF CHINA.

The Wall was built over 2,100 years ago by the Emperor Che Hang Te to keep out Tartar and other invaders. Including loops, it is nearly 2,500 miles long, and it had, roughly, a watch tower for every mile.



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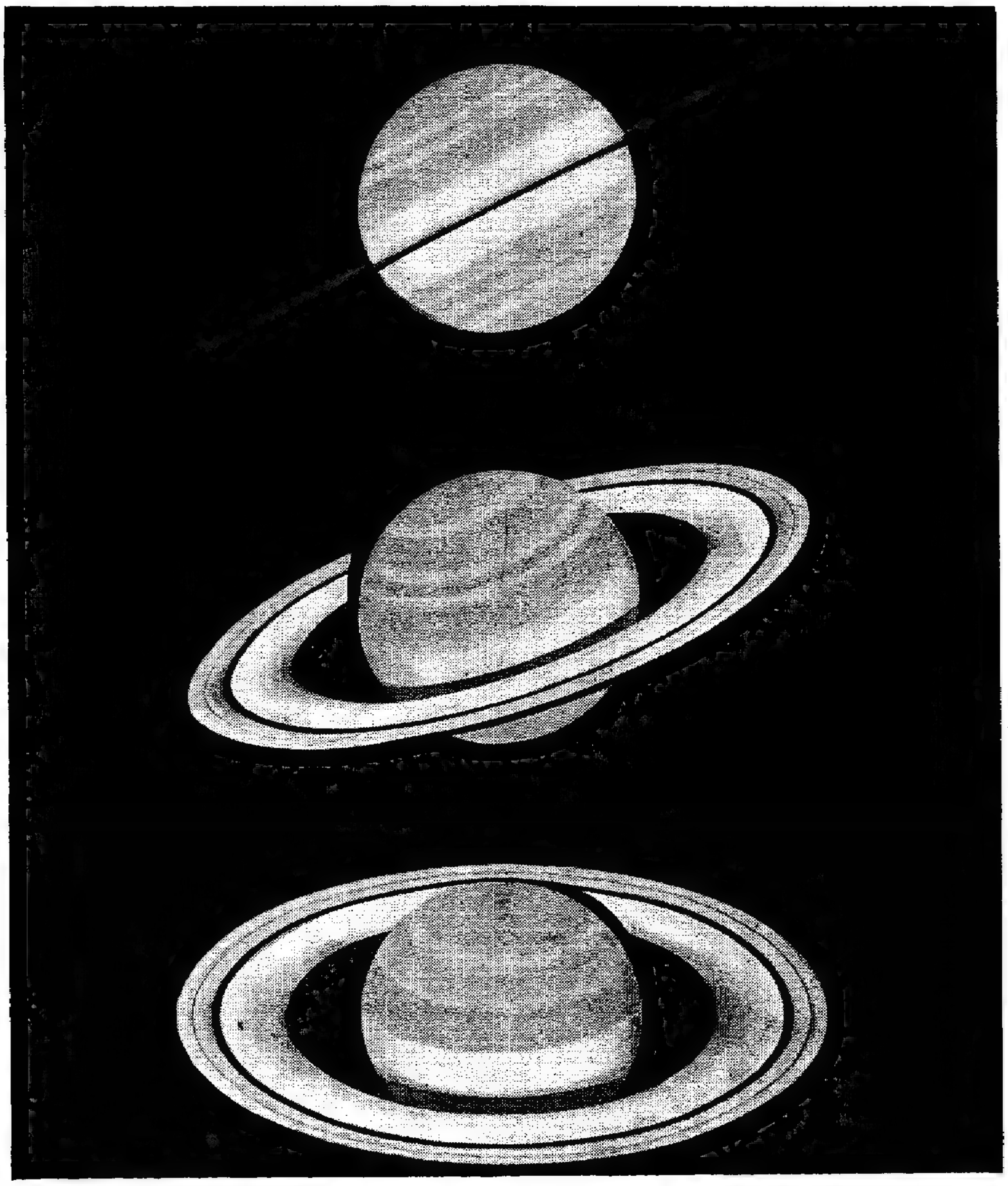
A SPUR INDEED!

The curious form of this giant cactus, in Arizona, is due to the wind having bent the top over until it touched the earth and took root. Note how small is the horse in comparison.

A Chat about the Planets

(With drawings by the Author.)

BY means of his telescope the astronomer is able to unlock the wonders of the Heavens and to lay bare some of the mysteries of those shining points of light in the midnight sky. Of all the objects he examines none can be of greater interest to us than the planets.



SATURN AND ITS RINGS.

Three views showing the appearance the planet presents on varying occasions according to the position from which the rings are seen.

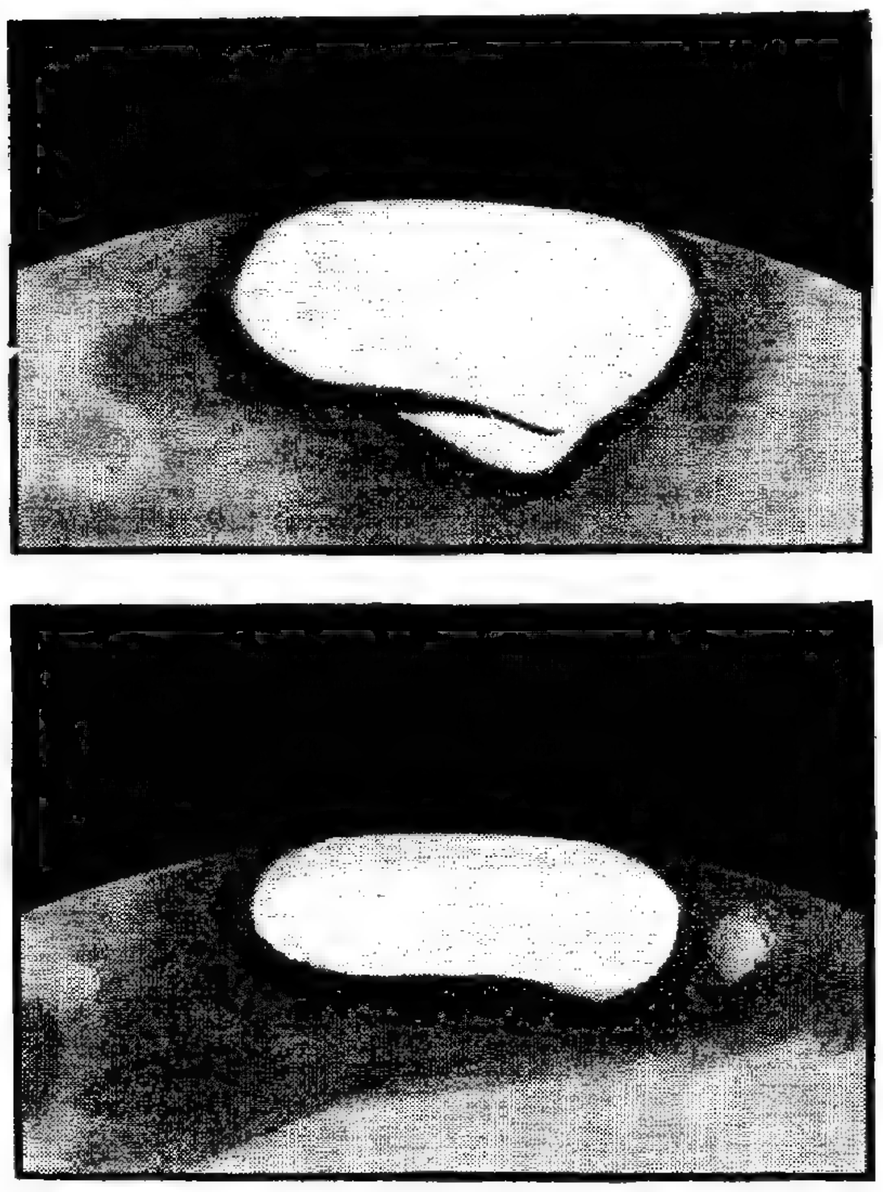
This is because our Earth is itself a planet, and with seven others circles around the Sun, the whole forming the group called the solar system. The Earth's seven sister planets are worlds, some larger, others smaller, and of all the thousands of heavenly bodies they most nearly resemble the Earth. Whether or not there are people on the planets we cannot tell, but many able astronomers think that life of some kind may exist on some of them. This may not be human life—

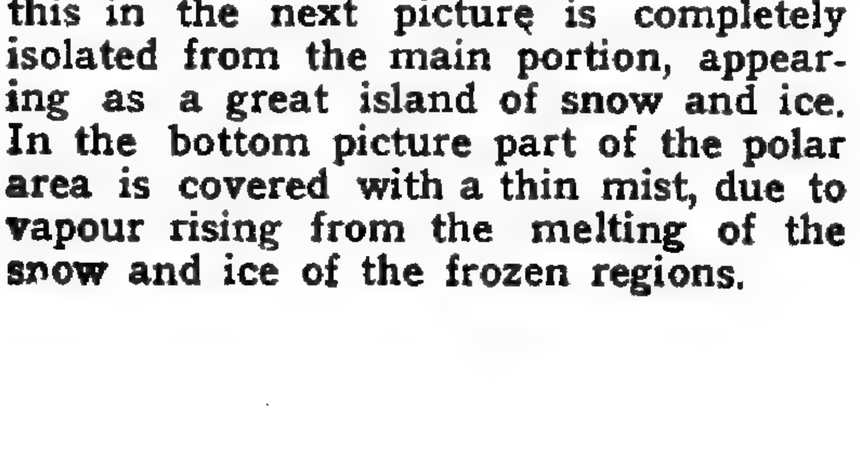
not even animal life—and indeed it is very difficult to imagine just what sort of life would be possible.

The names of the planets, in order of distance from the Sun, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. You may easily remember their order by thinking of this memory-aid :

"Men Very Easily Make Jugs Serve Useful Needs."

The initial letters correspond with those of the planets in order of distance.





MARS.

Three views of the south polar cap of Mars, showing changes in its appearance. The dark line surrounding the cap is water from the melting snow and ice. In the top picture is shown the formation of a rift—probably a great crevasse—and this in the next picture is completely isolated from the main portion, appearing as a great island of snow and ice. In the bottom picture part of the polar area is covered with a thin mist, due to vapour rising from the melting of the snow and ice of the frozen regions.

Each planet has some feature for which it is remarkable. Mercury is the smallest planet and the nearest to the Sun. Venus is the brightest planet and is called "the sister planet" to the Earth, because it is nearly the same size as the Earth. Mars is the planet with the strange markings that some astronomers claim to be canals. Jupiter is the giant planet and is surrounded by wonderful cloud-belts. Saturn is the most beautiful planet, the planet with a unique ring system. Uranus was discovered by Sir William Herschel in romantic circumstances. Finally Neptune, the outermost planet, was discovered on paper by clever mathematicians before it was seen in the telescope.

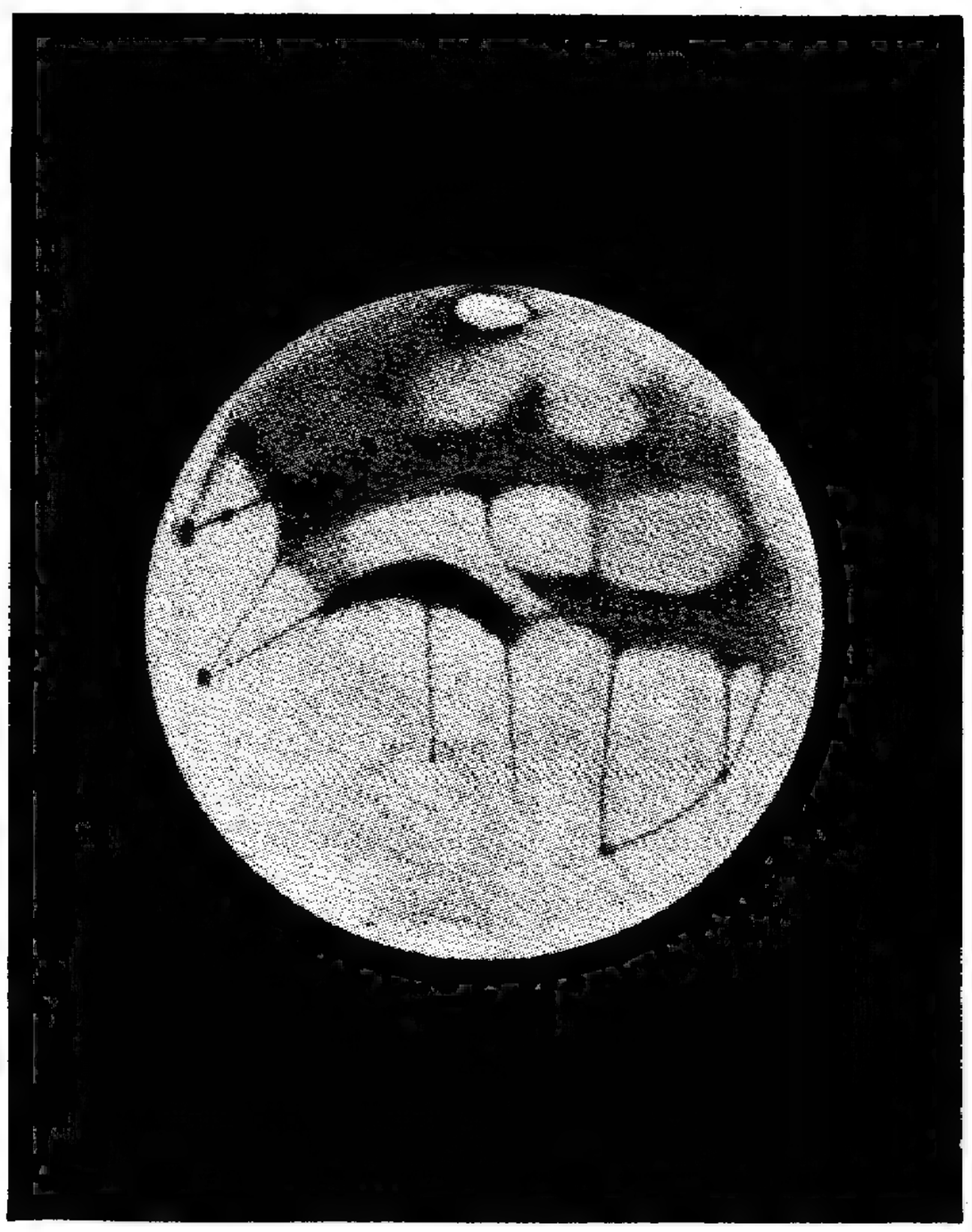
We have space to indicate only one or two of the planetary features that are of most interest.

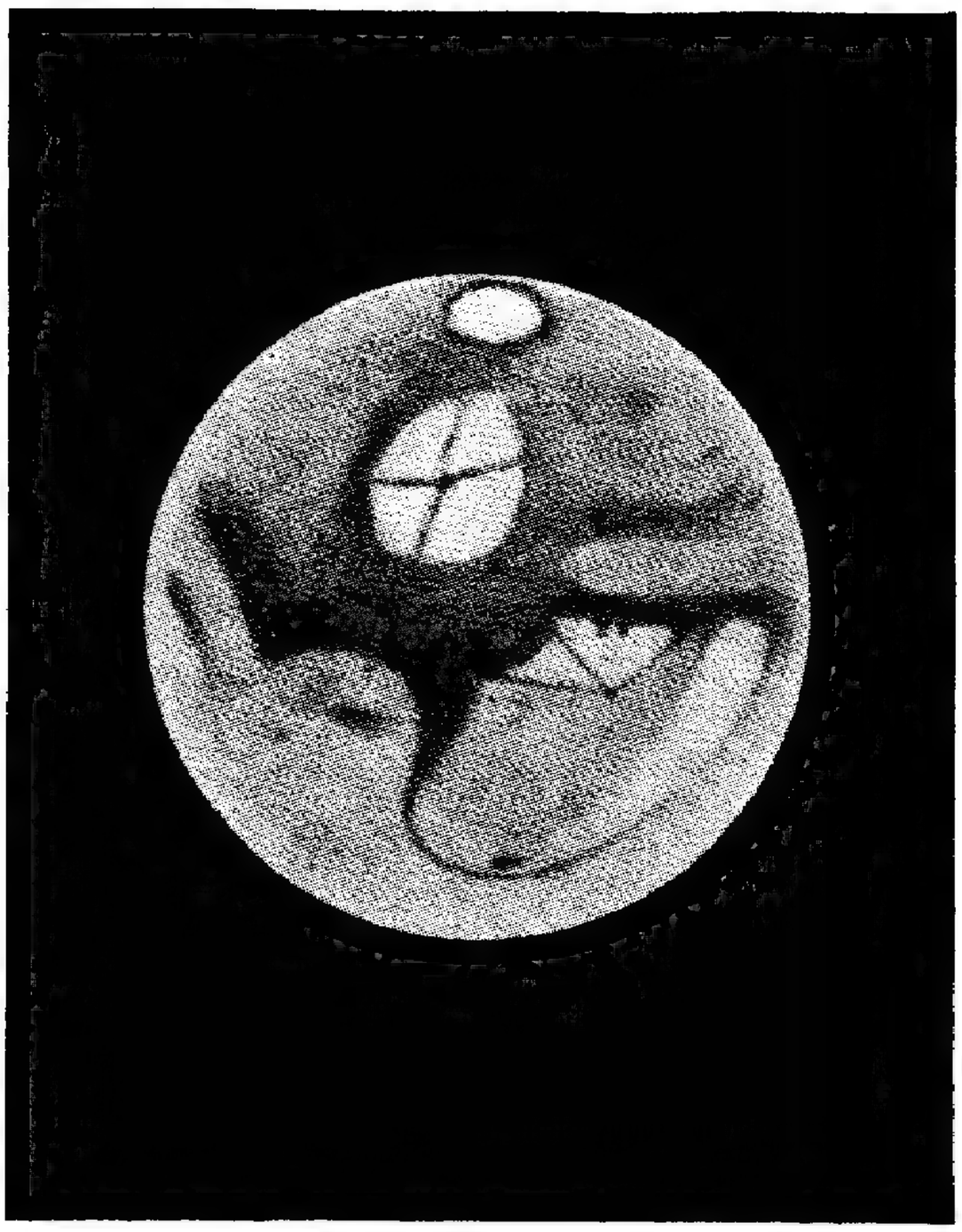
Mars must take the first place, for about this planet alone many books have been written. Mars was called by people of old "the fiery planet" because it shines with a red glare, almost like a watchman's fire seen at a distance. A large telescope shows that this peculiar colouring is caused by the golden sands of the great Martian deserts. Two kinds of markings are visible against the yellow,

desert-like back-ground—dark patches (believed to be areas of vegetation) and white regions of snow and ice. These regions correspond with the Arctic and Antarctic regions of the Earth and their snows melt and increase according to the Martian seasons.

There is neither cloud nor rain upon Mars. Another peculiarity is the absence of mountains. There can, therefore, be no rivers on that planet, and, it being reasonable to suppose that on Mars water is as necessary to life as it is on the Earth, it is a problem to know where the Martians, if there are any, get their water. The astronomers who believe that Mars is inhabited think that the Martians may obtain their water from the melting snow and ice of the polar regions. To enable this water to be distributed to all parts of the planet's surface they assert that the Martians have constructed great canals or channels. This, they say, is the only way in which we can account for the peculiar markings that run across the surface of the planet as shown in the illustrations on this page.

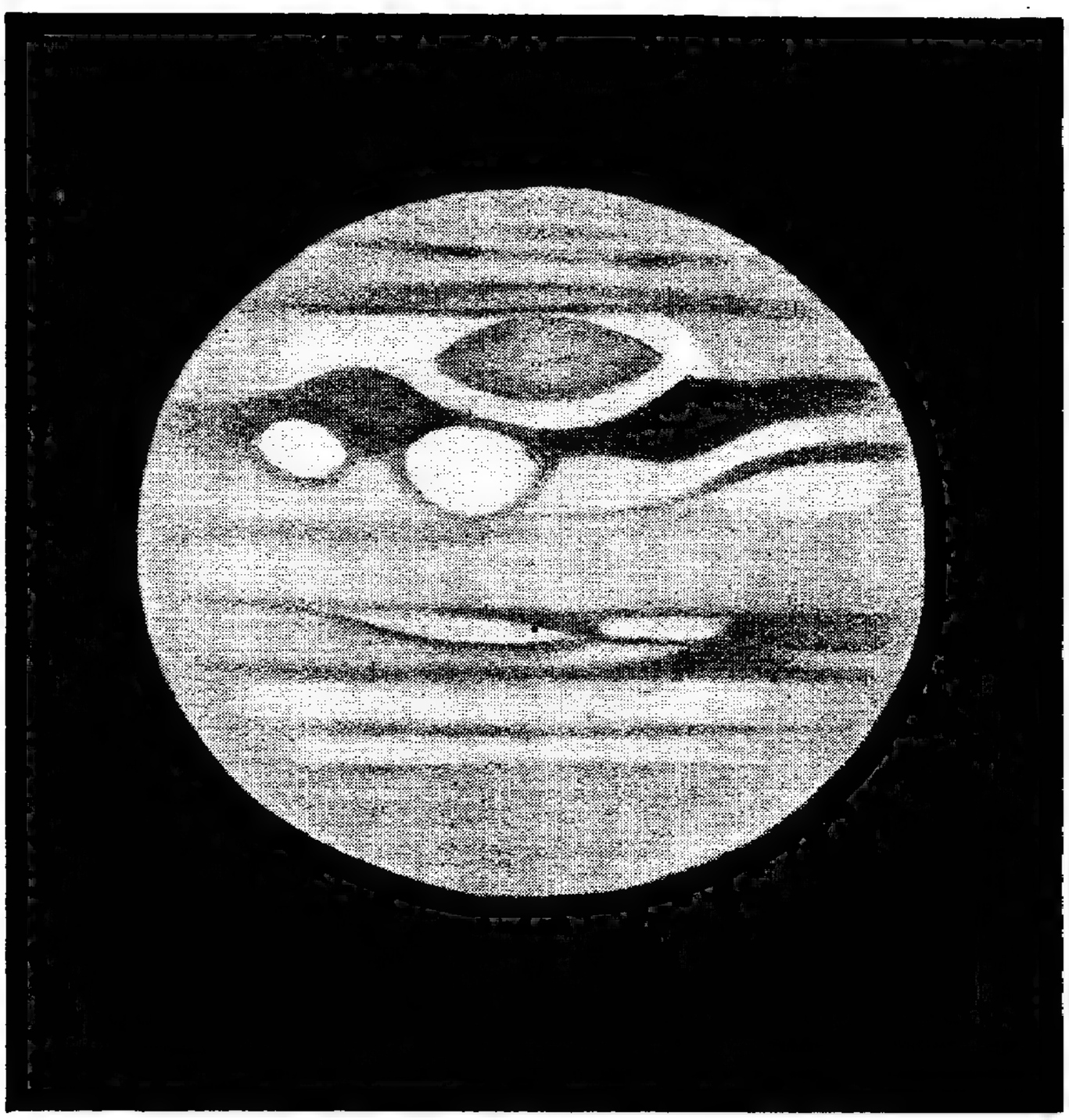
These markings are certainly most mysterious. Among the most notable of their peculiarities are (1) that many of them meet at some chosen place; (2) that they are perfectly straight and (3) that they are of a permanent nature, lasting for years. Whether these markings are really canals we cannot say with certainty. Some astronomers





MARS.

The two views show characteristic dark markings, the south polar cap, and some of the famous "canals."



THE GIANT PLANET JUPITER,

surrounded by cloud-belts, always parallel to its equator. The oval-shaped marking in the centre of the disc is the famous "Red Spot."

suggest that they are cracks on the planet's surface, others think that the observers have been deceived and that the explanation lies in some form of optical delusion.

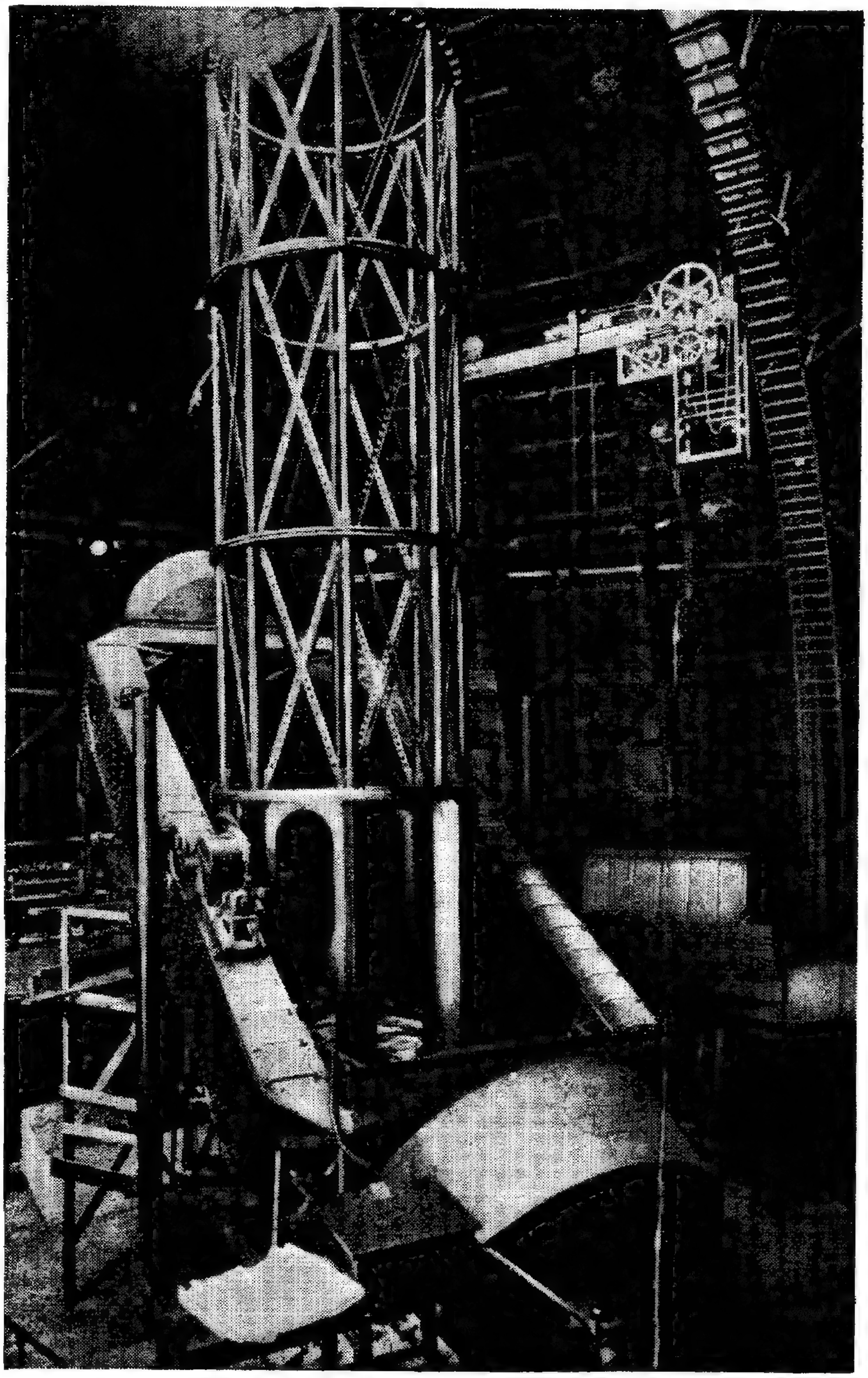
Jupiter is the largest planet in the solar system. If we had a huge pair of scales and placed Jupiter in one pan, we should require 1,300 worlds as heavy as the Earth to balance the beam. When Galileo, the famous astronomer, looked at Jupiter through his newly invented telescope he was surprised to see four tiny moons circling around the planet, just as our moon travels round the Earth. He called his friends to look at this wonderful and beautiful sight, for at that time it was believed that the Earth was the centre of everything. Galileo had already endeavoured to show that this belief was wrong and that the earth actually travels round the Sun. When he saw Jupiter and the four moons, he endeavoured to use them as an illustration of his theory, but the people would not believe him. They declared that he was a magician and had bewitched his telescope, and not till long afterwards was it established that the Earth is *not* the centre of the Universe.

A telescope shows a number of streaky lines running across the disc of Jupiter. These are thick clouds, which range themselves in belts parallel to the planet's equator. They are sometimes beautifully and delicately tinted, the colours varying from bright yellow to chocolate. Often great masses of white clouds are seen, resembling in some degree the "snow mountain" clouds of our own skies. Though Jupiter's clouds are constantly changing in appearance there is one marking that seems to be of a lasting nature. This is oval in shape and is called the Great Red Spot, for it is sometimes of a bright red colour. Many theories have been put forward to account for this

peculiar marking, but here again, as in the case of the "canals" of Mars, we do not really know.

One of the most splendid objects in the heavens is the planet Saturn. It differs from all the other planets because it is surrounded by beautiful rings. These rings can only be seen with a telescope; although they extend right round the planet, they do not touch it at any point. We see them sideways, or at an angle, and they thus resemble a plate held edgeways. Saturn's rings consist of multitudes of moons, each travelling around the planet in its own path, just as the larger moons of Jupiter travel around it. The moons composing Saturn's rings, however, are so tiny and so far away that even with our greatest telescopes we cannot see them separately. Instead, they appear as a beautiful ring of light surrounding the planet. The rings do not shine by their own light, nor does the planet itself, but reflect the light of the sun. The globe of Saturn is surrounded by cloud-belts something like those which encircle Jupiter, though the details are not so distinct, for Saturn is very much farther away from us.

ELLISON HAWKS.



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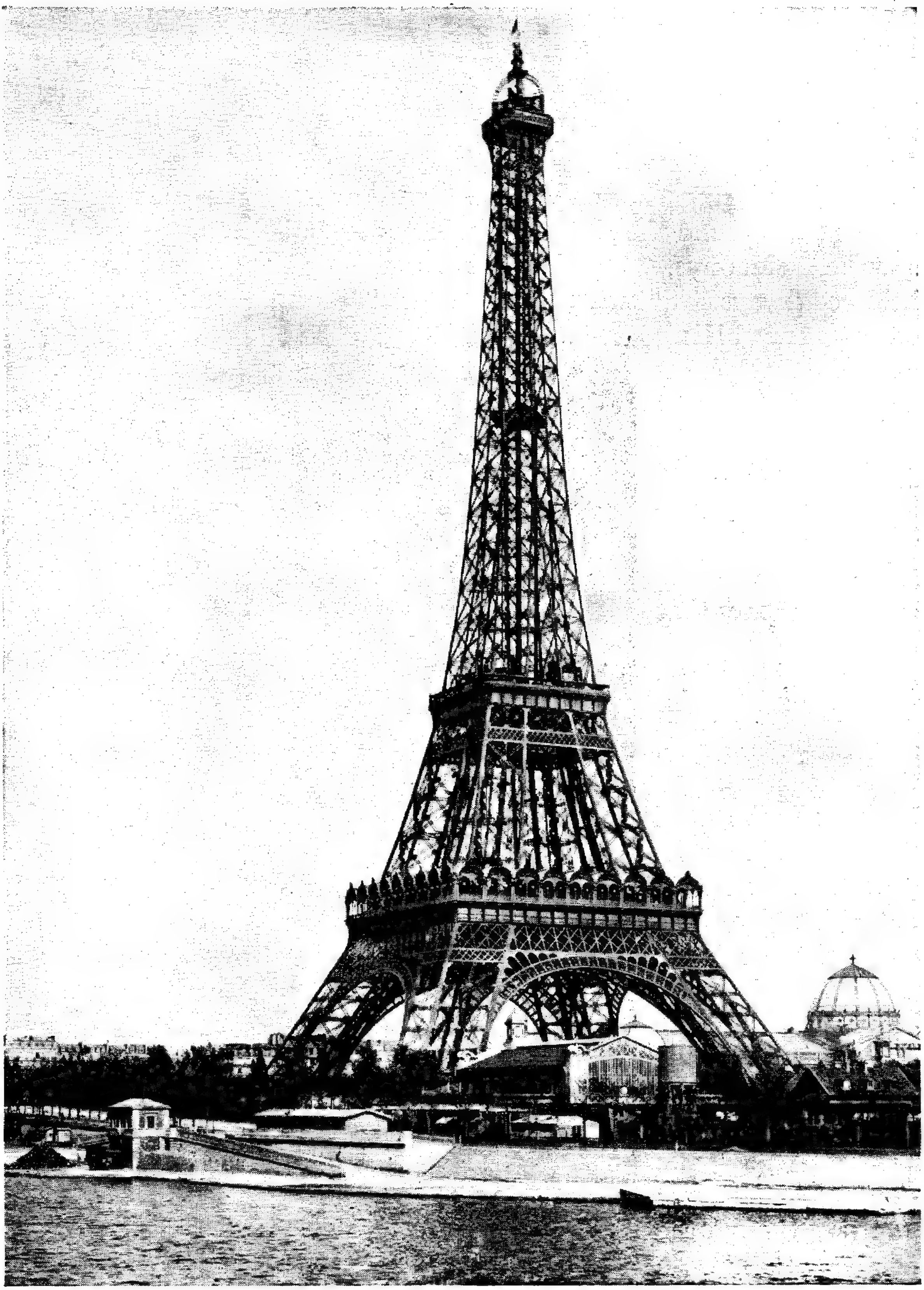
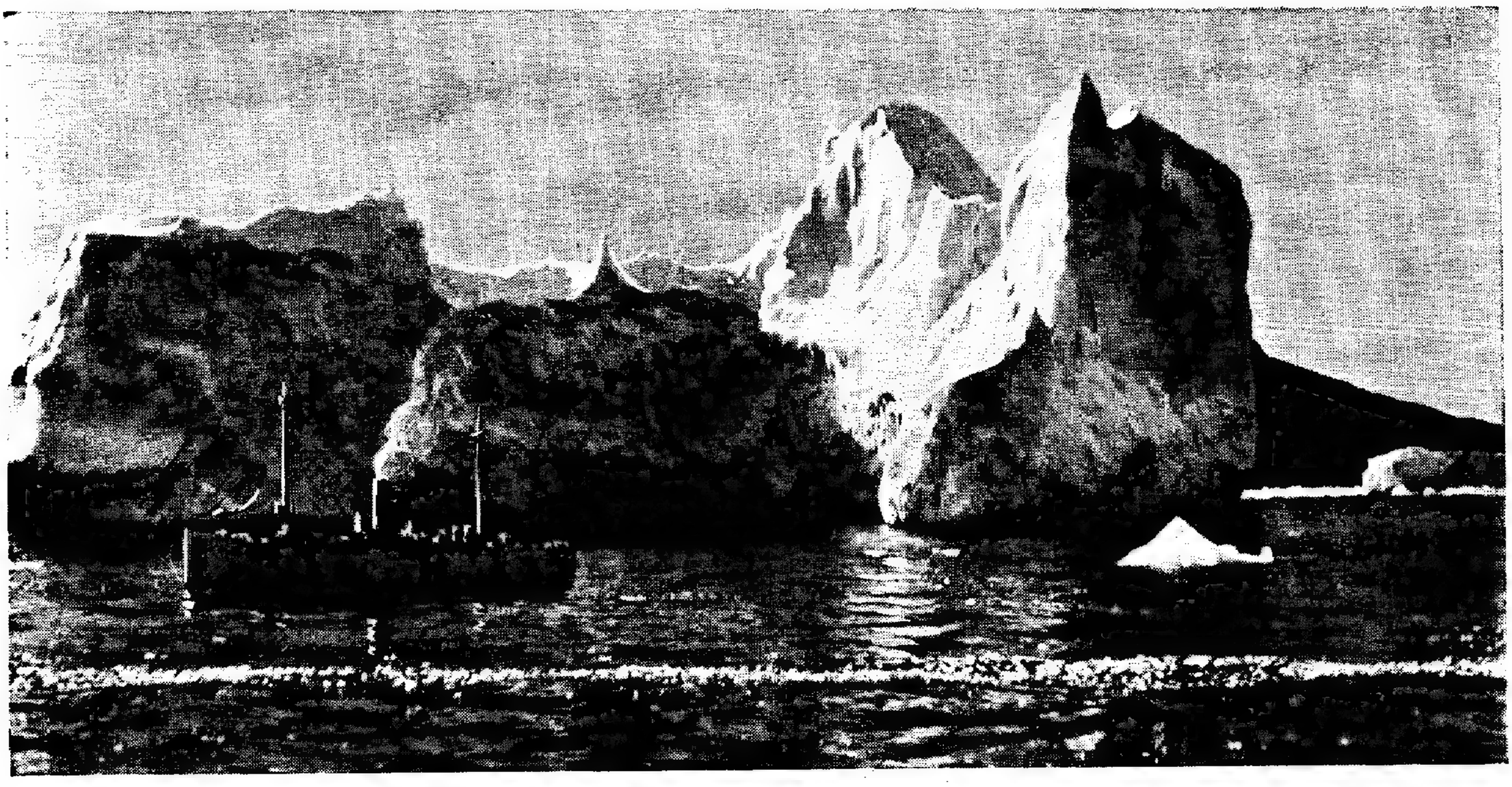
THE GREAT TELESCOPE AT MOUNT WILSON OBSERVATORY, CALIFORNIA.



THE EIFFEL TOWER, PARIS.

One of the most wonderful works of Man. The tower is nearly 1,000 feet high and the base covers a park-like area of 2⅓ acres. On the top platform is a very important wireless station.



[*H. J. Shepstone.*

AN ICEBERG.

The Aurora Borealis :

The Wonder of the Arctic Night

CAN you imagine what the earth would be like if the sun forgot to get up one morning? There would be no day at all—in fact, it would just be "night all day." That does not sound very cheerful, yet in the far North, in the Arctic Circle, the sun goes on strike for about six months of the year, and disappears altogether in October. From October right until about March is just one long night; yet this is not so bad as it sounds, for the sun, though unable himself to put in an appearance, sends radiant messengers from below the horizon far up into the skies above it, where the air is very thin, or "rarefied," and these electrical messengers, or "electrons," cause the atmosphere to glow and gleam in all varieties of colour. These beams of light are the cause of the wonderful Aurora Borealis, one of the most beautiful and inspiring sights on earth. Often the Aurora appears as a great arch, with flickering curtains of many-coloured lights hanging like shining gossamer in the sky, with ever-changing form and ever-changing colour, while shafts of light shoot from the top of the arch far up into the sky. Sometimes there is no distinct arch,

but waving bands or curtains of light appear in many forms, which dance and shimmer and change with such variety and beauty that it is an ever new delight to watch them. These coloured lights play on the pure white snow and icebergs, tinting them with lovely hues till the whole scene is like Fairyland. Dr. Nansen, the great Arctic explorer, thus describes one of the displays of the Aurora:

"The deck of the ship was brightly illuminated by the Aurora, and reflections of its light played all over the ice. No words can depict the glory that met our eyes. The glowing fire-masses had divided into glistening many-coloured bands, which were writhing and twisting across the sky. The rays sparkled with the purest, most crystalline rainbow colours, chiefly violet, red or carmine and the clearest green. Most frequently the rays of the arch were red at the ends, and changed higher up into sparkling green, which quite at the top turned darker, and went over into blue or violet before disappearing in the blue of the sky; or the rays in one and the same arch might change from clear red to clear green, coming and going as if driven by a storm. It was an endless phantasmagoria of sparkling colour surpassing anything that one can dream."

On another occasion he says: "The prevailing colour at first was yellow, but that gradually flickered over into green and then a sparkling ruby-red began to show at the bottom of the rays on the under side of the arch, soon spreading over the whole arch."

It must be a wonderful world the young polar bears see when they first come out of their snow cavern. They are born in mid-winter, and spend the first two months or so of their lives in the cavern, cared for only by their mother. When March comes, she thinks it time to give the youngsters a first peep at the world they live in, and to teach them some of the many things that good young polar bears should know. It is in March that the Aurora Borealis is generally at its brightest. A little later the sun reappears, and shortly he will go to the other extreme, and never set at all, so that for the rest of the summer there is day all the night!

Scientists experiment by passing electric currents through rarefied air, with the result that many-coloured lights are produced, just as when the sun from far below the horizon shoots its mysterious electric messengers up to brighten the long night of the Arctic regions.

A. J. B.

AURORA BOREALIS, OR POLAR LIGHTS.

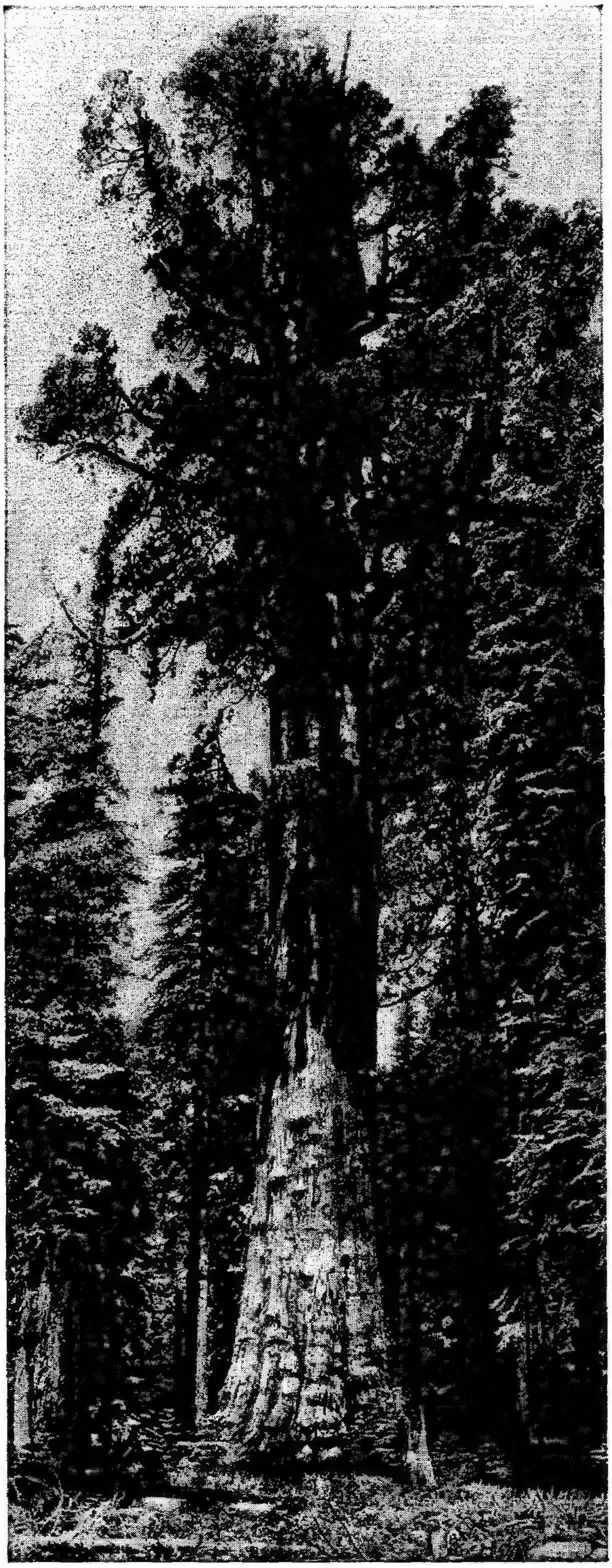
Many people in Great Britain and Canada have seen at times the "Northern Lights," and Australians and New Zealanders may witness the "Southern Lights," or Aurora Australis, but only those who penetrate well into Polar regions can hope to see such a sight as that depicted above. The phenomenon is believed to be due to solar rays, the "lights" being always more vivid when "sun spots" are prominent.

Big Trees that may be Five Thousand Years Old

ON the mountain-side in a certain part of California the "Big Trees," or Redwoods, grow. No other trees can be compared with them—they are the "noblest of a noble race." Some seventy years ago a hunter, chasing a bear, suddenly came across a grove of these mammoth trees and, overwhelmed with amazement, hastened back to tell of his astounding discovery. And so the world came to know of them, and they were named *Sequoia* by the scientists after a great Indian chief, Sequoyah.

Now the Redwoods are marvellous, firstly, because of their size. Imagine three big oak trees piled one on the top of the other and you will arrive at nearly the height of a Redwood. Specimens have been found which tower aloft for 340 feet, almost the height of the cross above the dome of St. Paul's Cathedral. And their girth is in proportion. The "General Sherman" tree is said by the United States

W.B.W.



[*E.N.A.*

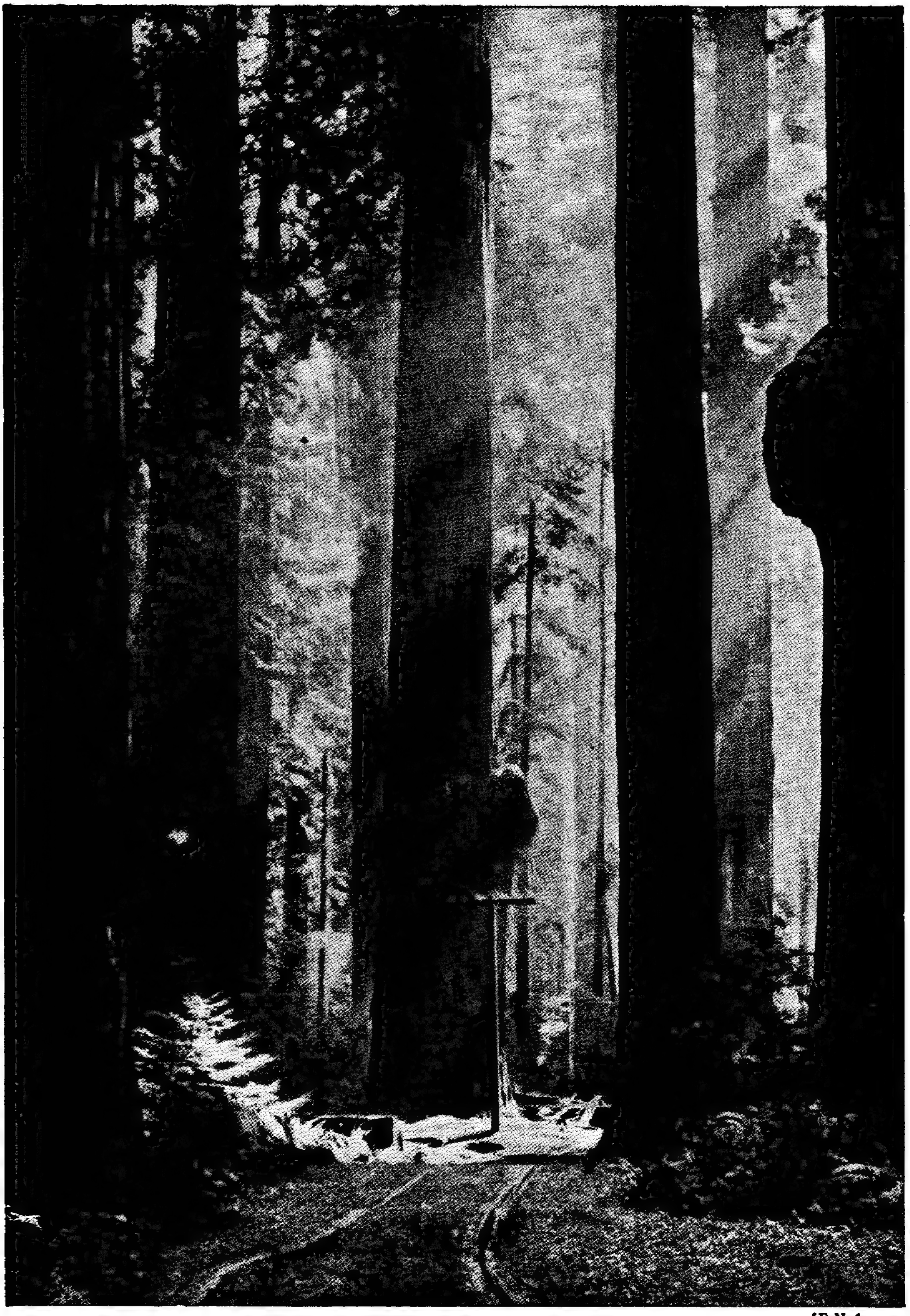
BELIEVED TO BE THE OLDEST LIVING THING.

The "General Sherman" Tree, Sequoia Park, California. It is 280 feet high; circumference of base, 102 feet; its greatest diameter, 36 feet; and 100 feet above the ground its diameter is 17½ feet. Some of these trees attain a height of 340 feet.

[E.N.A.

THE BIGGEST TREE IN THE WORLD.

It takes twenty men with arms outstretched to encircle this tree.



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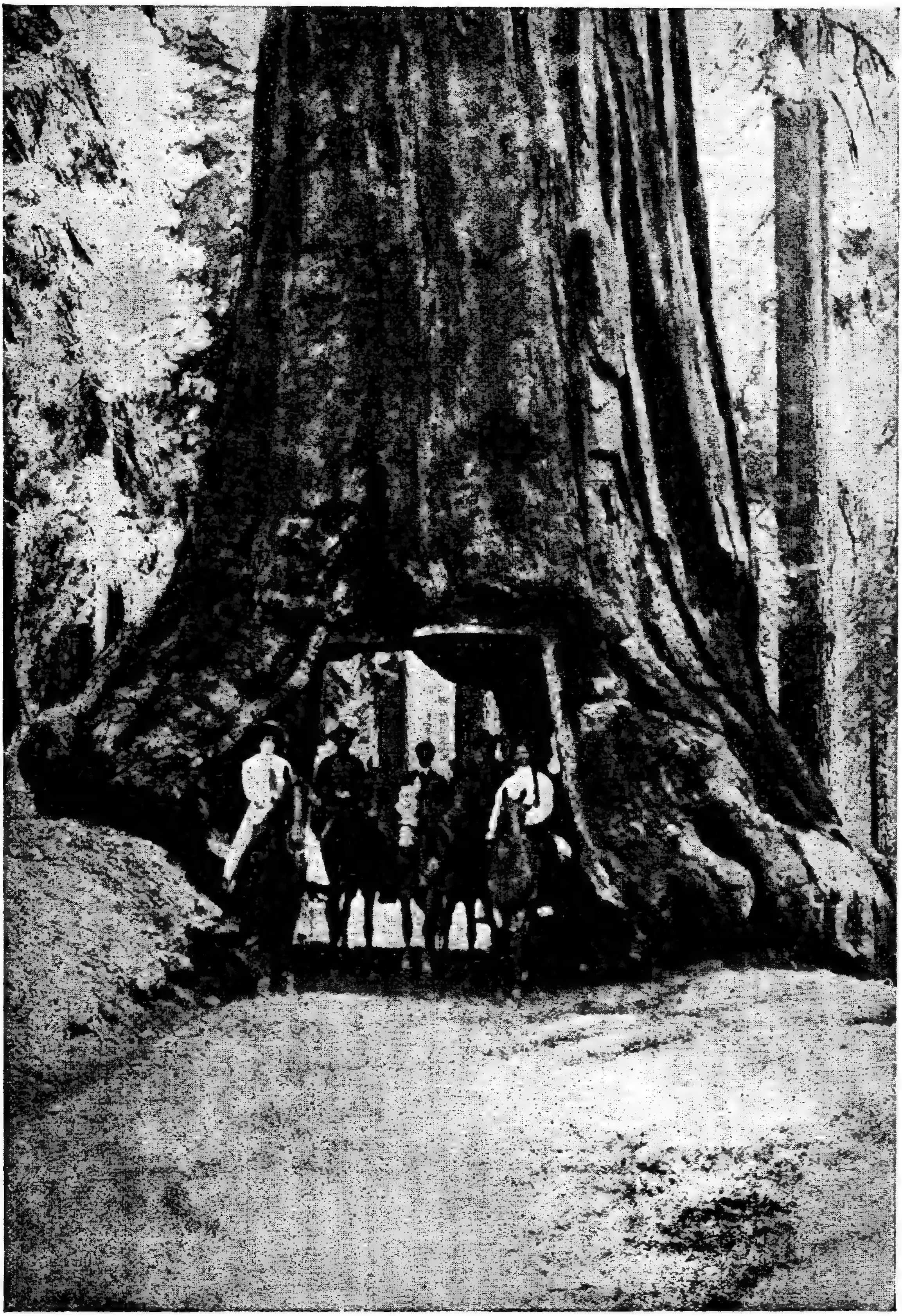
SUNLIGHT AND SHADOW.

Among the giant Redwoods of California.



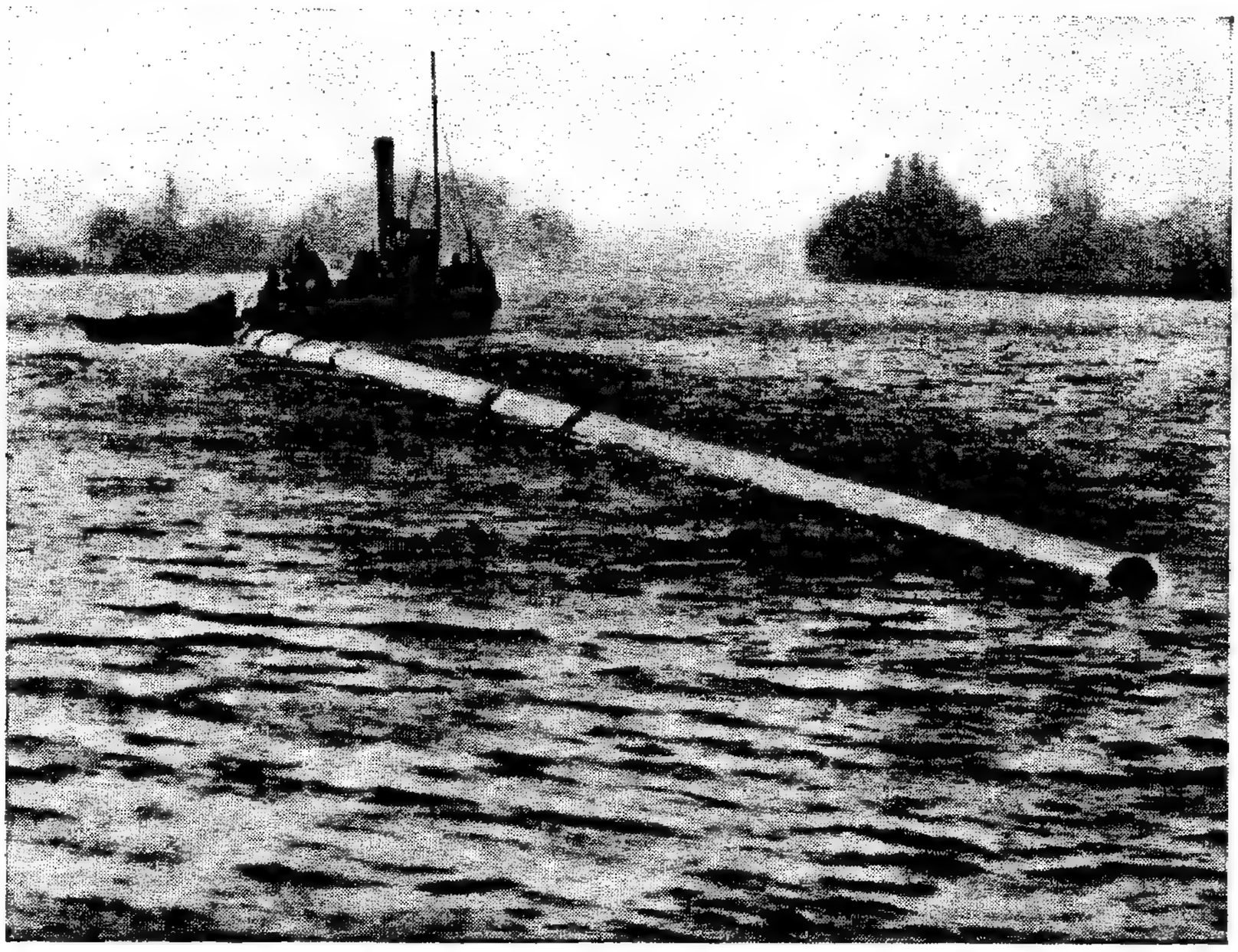
[*E.N.A.*

WAWONA, ANOTHER OF THE FAMOUS BIG TREES OF CALIFORNIA.

This monster is over 300 feet high. The tunnel in the base is 30 feet through and takes a four-horse stage-coach with ease.

Government to be the biggest in the world, and takes twenty men with outstretched arms to encircle it. A diameter of 18 to 22 feet is not uncommon. The so-called "Father of the Forest," now lying prostrate, has a tunnel through it along which a man might ride. On the section of another trunk a dancing floor has been made which can accommodate a large party, while a cabin of considerable size is hollowed out of the base of a still living tree. Quite a number of Redwoods, it is said, contain 100,000 feet of good saleable timber.

The Redwoods are marvellous not only for their size but for their age. The seniors among them are by far the oldest of living things. How old we do not know. Some experts say as much as *five thousand years*, and it is certain that some of those which look by no means old are well over half that age. *And they are still growing.* A traveller recently said, "I never saw a 'Big Tree' that had met a natural death. Barring accidents they seem immortal." Man is their chief enemy. Large numbers have already been cut down wastefully as timber, others destroyed by fires started accidentally or wilfully. The "muttoneers," herding immense flocks, are the chief offenders, burning and destroying to improve the pasture for their sheep. The American people have, however, started a "Save the Redwoods" campaign to secure the trees from further harm. By a beautiful inspiration one of these groves has been bought and dedicated to the memory of a hero who fell in the Great War, and so, to countless generations yet unborn, it will stand as a symbol of his energy and lofty endeavour.



[*Illustrations Bureau.*

SAID TO BE THE TALLEST FLAGSTAFF IN THE WORLD.

This pole, of Douglas fir from Vancouver Island, is in Kew Gardens. It is 215 feet high and weighs 18 tons. The picture shows the pole being towed up the Thames.

The Redwoods are allied to the firs and cedars. They bear large

numbers of small green cones: out of a single cone as many as 300 seeds will fly, but the squirrels eat the greater number.

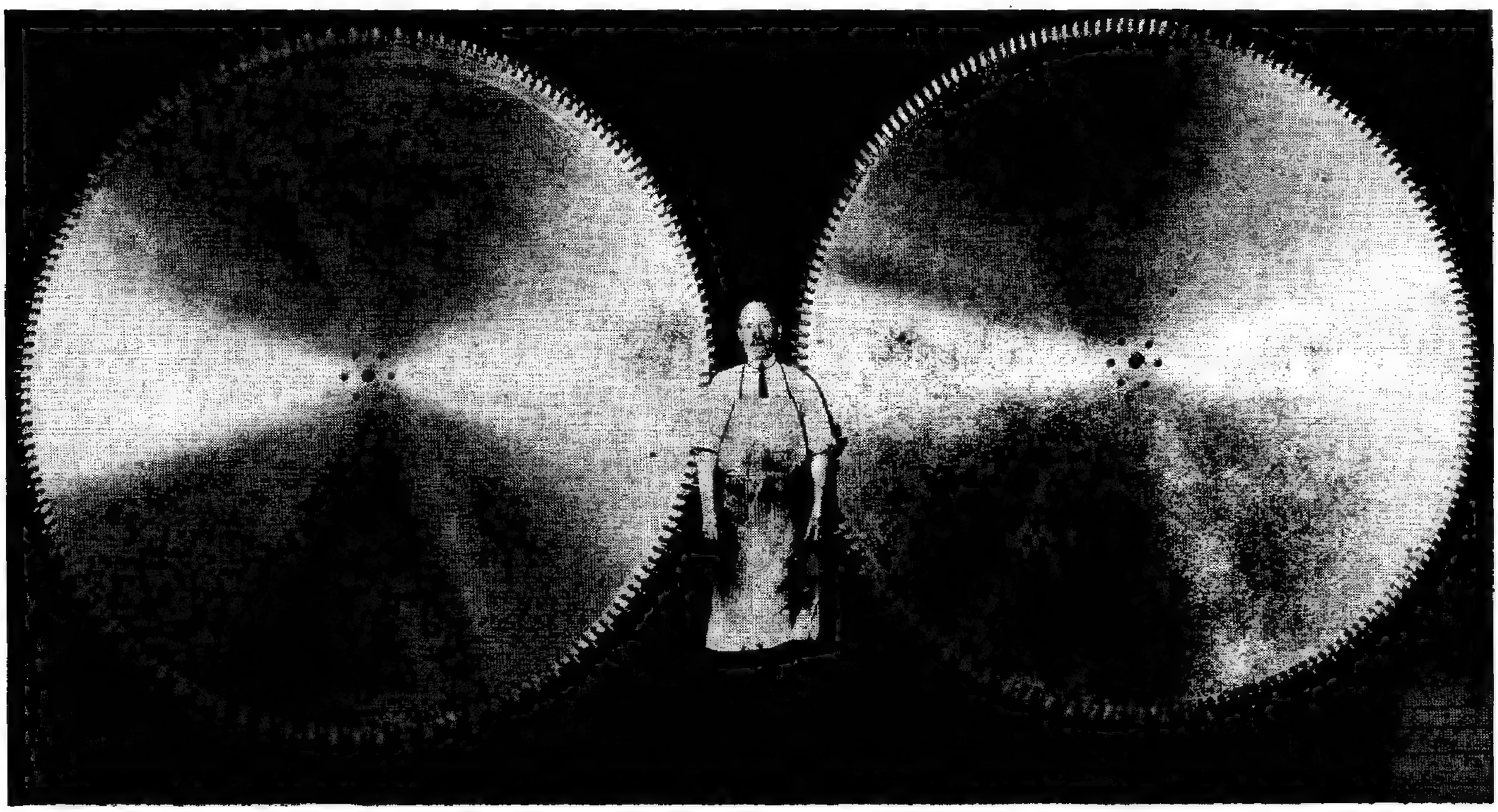
Seeds of the Redwoods began to be sent to England some sixty years ago, and now in many parks and gardens "Wellingtonias" (as we call the Redwoods) may be seen. They are already fine trees, but they are still only in their babyhood. What England will look like when the "Big Trees" grow up no man can foretell, for that is far down the centuries.

G. CLARKE NUTTALL.

Big Saws

TO cope successfully with the huge logs taken from a certain part of British Columbia, where firs and cedars reach an enormous thickness, these two circular saws, the largest ever made, were specially designed by Canadian engineers. Each has a diameter of nine feet, with a hundred and ninety detachable teeth of the spiral inserted type, which can be removed when broken and new ones substituted without taking down the saw. Each saw was originally an ingot weighing 1,140 pounds. After the reheating, rolling and trimming processes were finished, the great blades still weighed 795 pounds each. They are said to attain a speed of 130 miles an hour when in motion, and no log can resist them.

H. J. S.



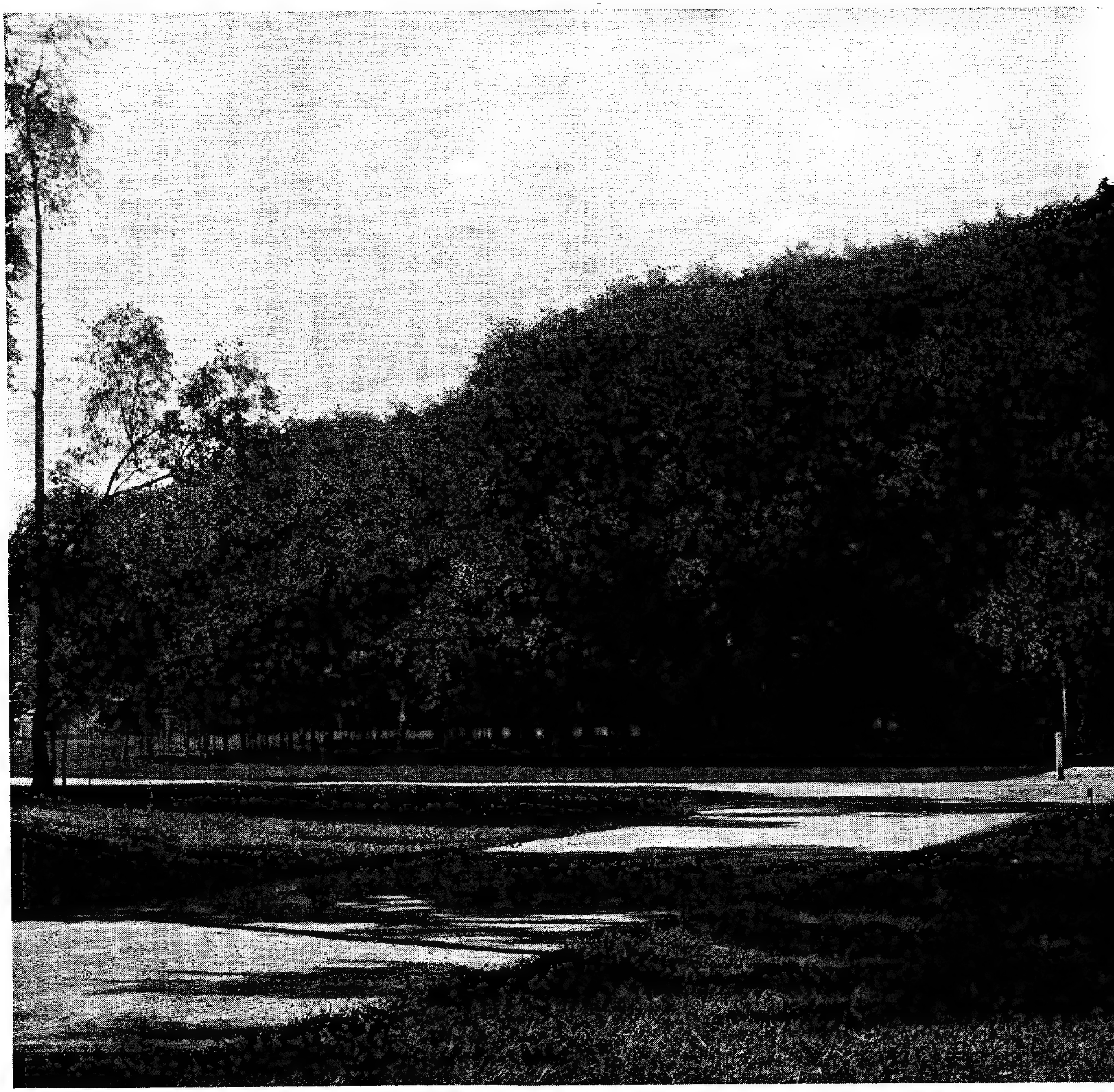
[*H. J. Shepstone*

THE WORLD'S BIGGEST CIRCULAR SAWS.

[*E.N.A.*

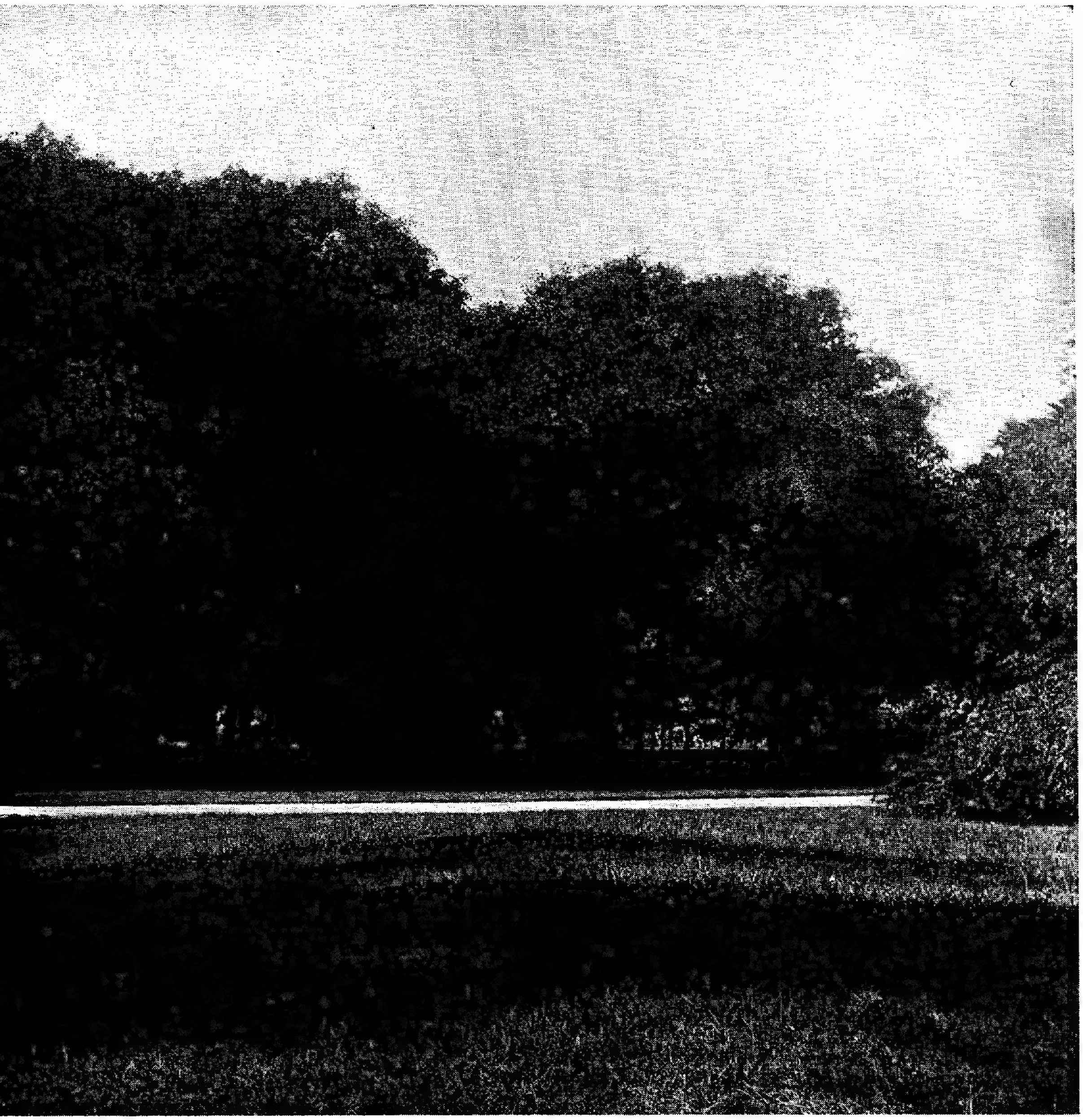
A CACTUS "HAND," WITH THUMBS AND FINGERS, ARIZONA.

Cacti often grow to enormous heights. One variety, the Torch Thistle, has been known to reach 60 feet.



A Wonderful

THE Banyan, or Bengal Fig Tree, has a very remarkable life. It generally grows from a seed that a bird has let fall upon some other tree. As the seed grows it feeds upon the " host " tree and eventually kills it, but not until it has its own roots firmly established in the ground. Its branches, too, are very remarkable, for they send down roots to the ground and thus form supporting props. This process goes on and on and the branches spread until there are hundreds of columns, and the area covered by the tree is very great and always increasing. No other tree in the world is like it. Our picture shows the famous Banyan Tree in the Botanical Gardens of Calcutta. It was born from a seed that fell on a date tree about a hundred and sixty



E.N.A.

Banyan Tree

years ago. Now the tree has over five hundred column-like roots reaching from its branches to the ground, and covers a piece of land a third of a mile in circumference. Many hundreds of people can take shelter beneath the tree at a time, and as it is still vigorous and comparatively young no one can say to what immense size it may ultimately attain. There is another famous Banyan tree on an island in the river Nebrudda, which at one time could shelter seven thousand people, but a storm washed part of it away, so that now it is little bigger than the Calcutta one.

The Banyan is a sacred tree and must not be destroyed. It is frequently planted in India by the road-side as a shade tree, so that travellers may rest beneath it.

The Strongest Doors in the World

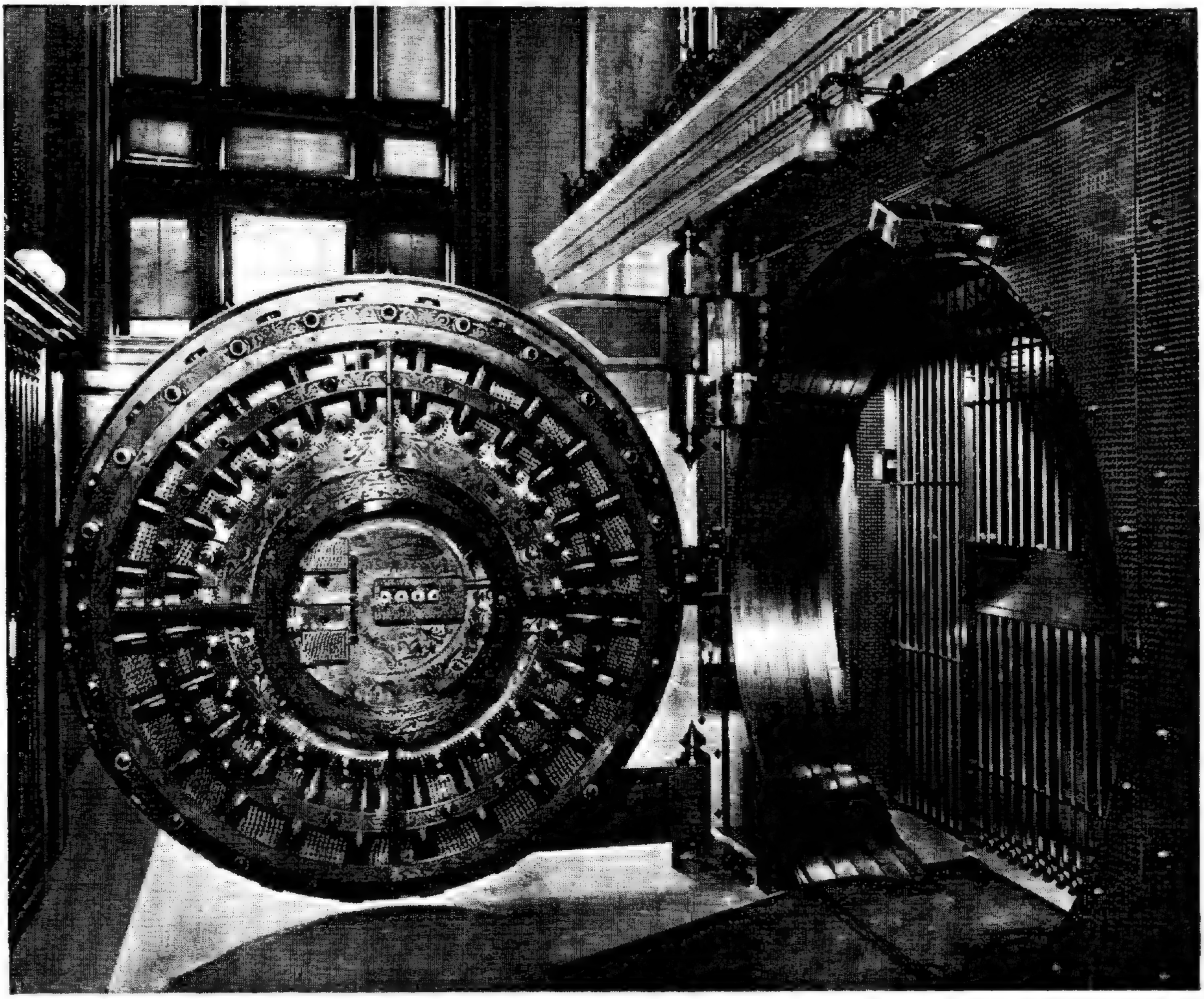
THE strongest and most wonderful doors in the world are those that guard the treasures in the great banks, insurance offices, and safe deposits. They are massive pieces of steel, weighing several tons, and boasting a formidable array of bolts, combination locks and timepieces. Once closed, no burglar could hope to open them, for they are proof against every form of attack.

In Great Britain bankers and safe deposit managers prefer rectangular, or straight doors, but in America circular openings are favoured. The doors of the strong-room of the Bank of England, one of the largest vaults in the world, weigh four tons apiece. When it is stated that there are now strong-room doors weighing twenty tons and more, those that give entrance to the vault of the Old Lady of Threadneedle Street would appear to be on the fragile side. But the Bank of England doors are 12 inches thick and wrought of undrillable steel. The great strong-room is further protected by beds of concrete and reservoirs of water. Sixty feet below the street level is a bed of concrete 20 feet thick. Above this is a lake of water 7 feet deep, and above that the strong-room proper, built of thick plates of steel specially manufactured to resist both skill and force. Anyone attempting an entrance from above would find a similar bed of concrete, a similar lake, and similar plates of steel.

Curiously enough, the doors that give access to the vaults, or strong-rooms, of the National Safe Deposit have no locks at all. In this, the oldest safe deposit in Great Britain, are thirty-two great armour-plate vaults, built up in four tiers. The outer walls are 13 feet thick. Next comes a passage, then thick walls again, lined inside with armour-plate dovetailed in sections and strengthened by wrought-iron framing. The doors leading into the vaults, or strong-rooms, are 12 inches thick and weigh nearly five tons each. As already stated, they possess no locks, but are closed and opened by hydraulic power. When the machinery which operates the doors has done its work, it is disconnected, and should any would-be robbers attempt to reconnect it, they would simply release the water in the cistern above the vaults, the place would be flooded, and the miscreants, unless promptly arrested, would be drowned like rats in a trap.

The most elaborate of strong-room doors are those at the Carnegie Safe Deposit in New York. Two years were spent in their construction

and erection, and the cost amounted to over £100,000. The vaults virtually consist of two huge steel boxes, placed one above the other in the basement of an American skyscraper. The lower receptacle is 180 feet long, 31 feet wide and 10 feet high; the upper 85 feet long, 20 feet wide and 10 feet high. They are made of the best Harveyised nickel-steel armour-plate. In all, some 1,400 tons of this metal were employed,



[*H. J. Shepstone.*

THE STRONGEST DOOR IN THE WORLD.

The huge circular door of the Carnegie Safe Deposit, New York. It is 7½ feet in diameter and weighs 25 tons. Each of the twenty-four radial bolts weighs 100 lbs. The door has four time-locks.

a greater quantity than is used in the construction of a modern warship. None of the plates of which these vaults are constructed weighs less than five tons, and some turn the scale at fifty and sixty tons. Indeed, the two biggest plates are the largest pieces of armour-plate ever forged for any purpose.

These plates, which form the shell of the vaults, are 5 inches thick, except at the openings for the doors, where the armour is 18 inches

thick. No bolts or rivets were used, the plates dovetailing into each other in such a way that the structure is, to all intents and purposes, a solid piece of metal. Any force applied to the joints only has the effect of tightening them. As a further precaution, a fire-wall of concrete, 12 feet thick, was laid around the vaults, except, of course, at the doors.

Access to these strong-rooms is gained through two round doors, each of which weighs twenty-five tons. They are the largest and heaviest round doors ever made. Twenty tons of the weight are in one solid mass of material, $7\frac{1}{2}$ feet in diameter, while the remaining five tons are accounted for in the bolt-work and the mechanism operating the locks. There are twenty-four round bolts in each door, each weighing 100 lbs. An electric motor, hung on the inside of the door, gives power to the gear which operates the bolts.

The locks are most ingeniously constructed. First comes the timepiece, capable of operating at periods varying from one hour to three days. When the door is closed

[*H. J. Shepstone.*

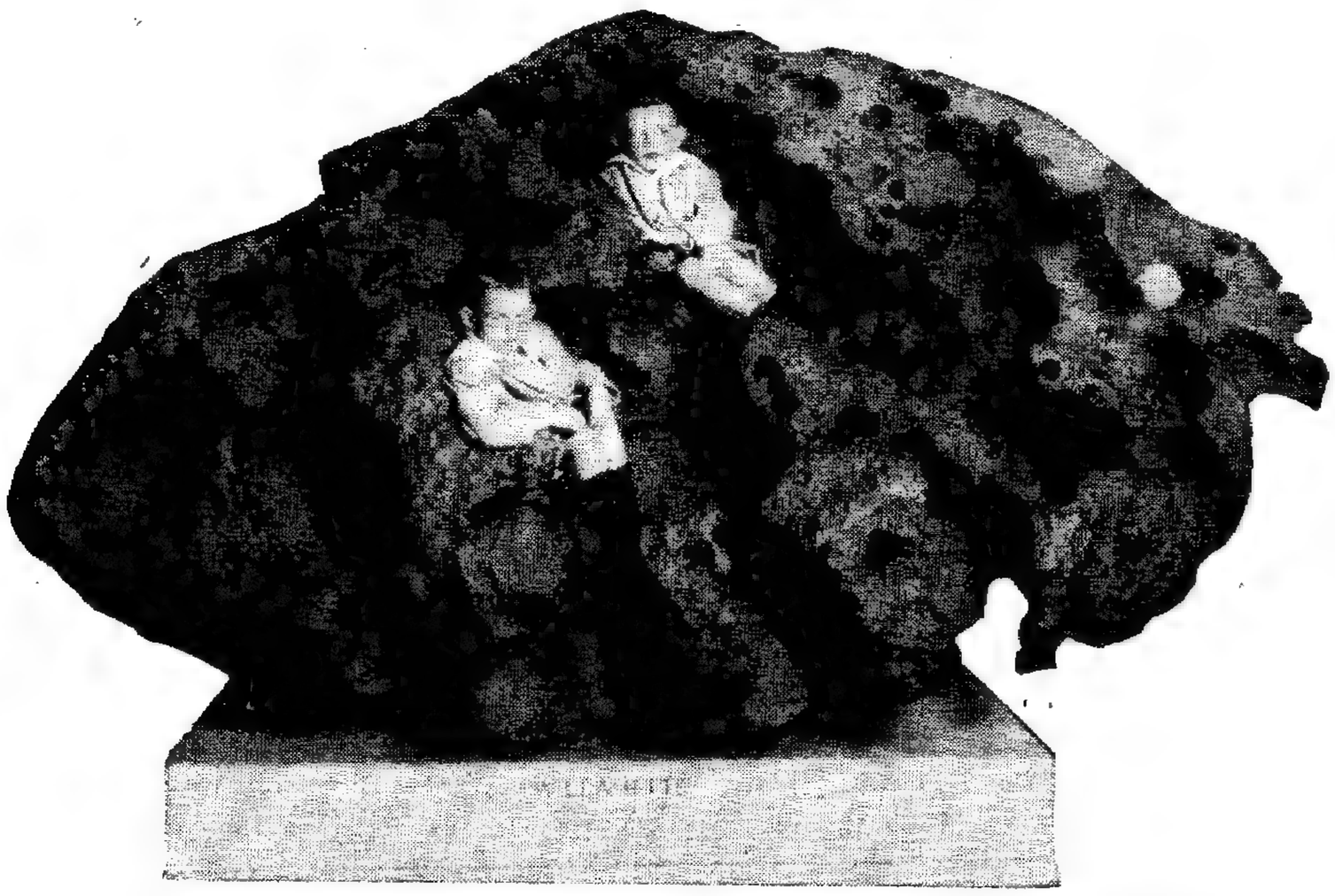
Rows of small safes for individual subscribers in the strong-room of a Safe Deposit.

the clock is set at the hour when it is desired next to open. Thus, the responsible official on shutting his strong-room door at night sets the timepiece for nine o'clock next morning. This means that the lock will not operate until the timepiece has run its course.

In addition to the time-lock there is a combination lock, and unless one knows the combination it is impossible to open the door. This combination may consist of a number, or of a letter of the alphabet, or of a series of letters or numbers, known only to the one who actually closed the door and to the officials of the bank. It may, moreover, be an automatic combination lock, having twenty or more keys, any of which can lock the door ; but the same key must be used to unlock it, as the key automatically sets the mechanism in favour of itself. With such a lock it is possible to have a different key for every day of the month ; thus, if any key got into wrong hands it would be useless unless it happened to be the one which last locked the door. In addition, it would be necessary to know the combination.

It can be said of these strong-room doors and the vaults they protect that they are not only burglar-proof but proof against every possible form of assault. If the most deadly explosives were trained on them, they would not be beaten in. They are the last word of engineers and locksmiths against the scientific burglar, and it is safe to say that there are few things fashioned by man which have undergone such wonderful improvements.

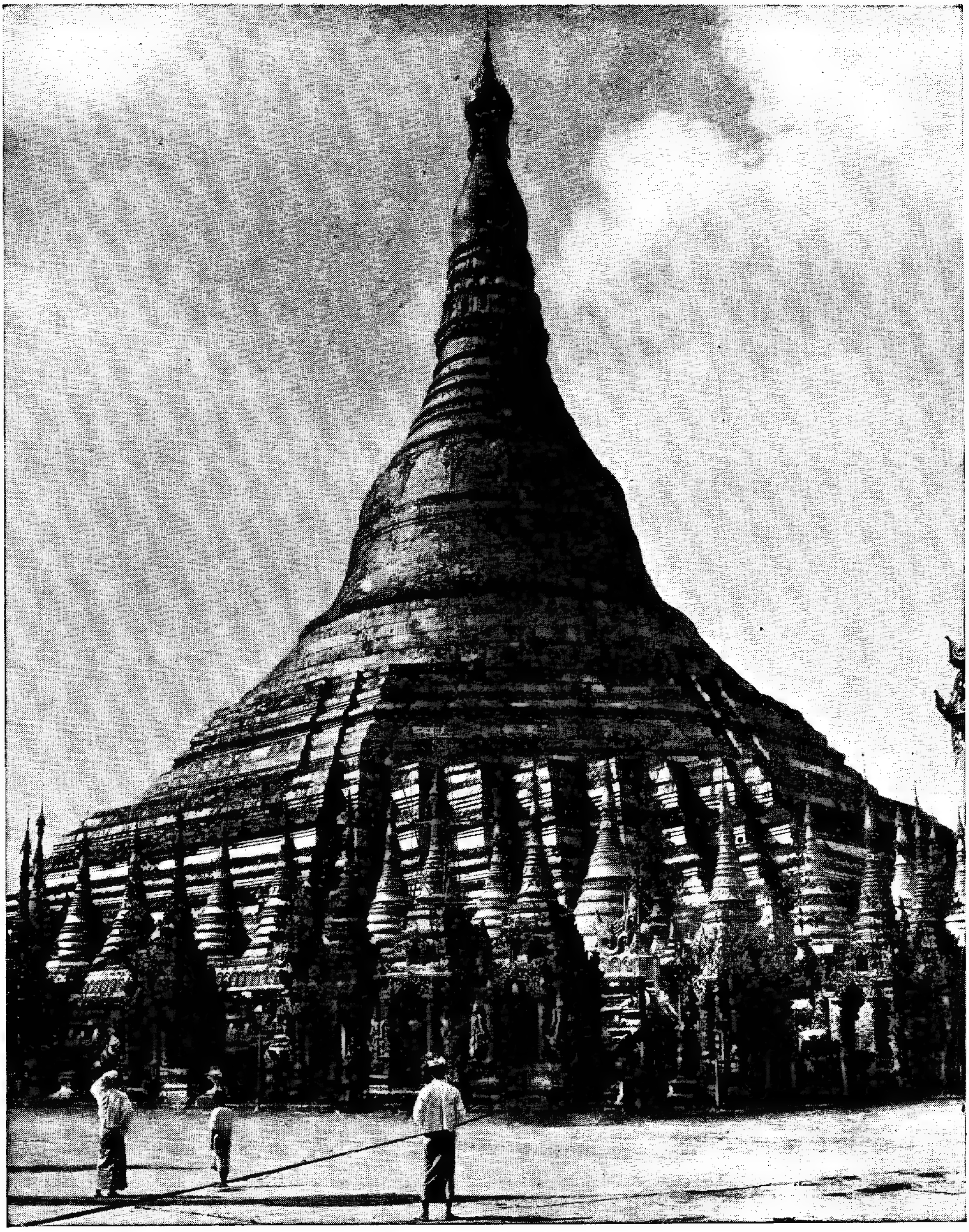
H. J. SHEPSTONE.



[Photo by American Museum of Natural History.

THE WILLIAMETTE METEORITE.

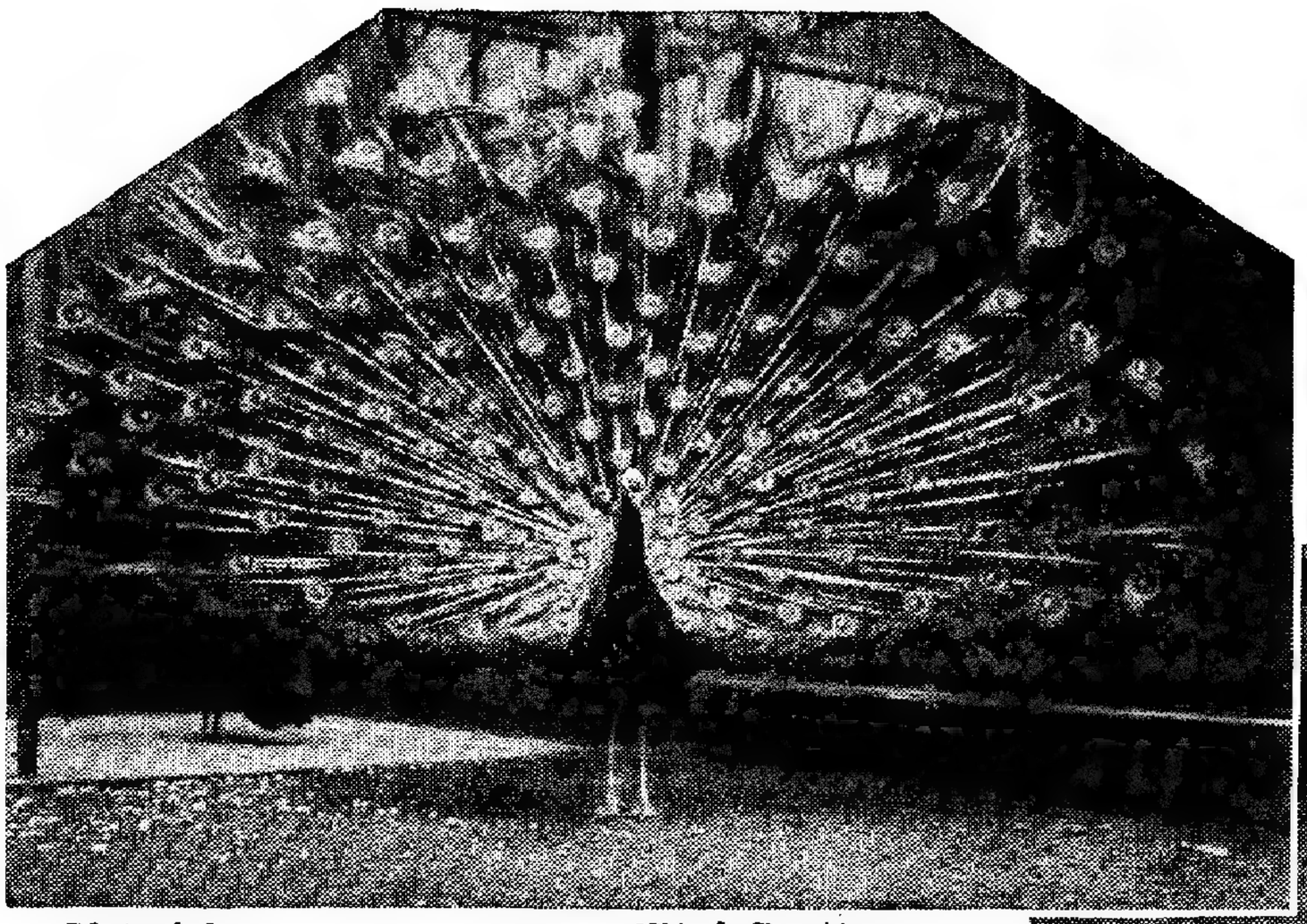
Meteorites, sometimes known as " shooting stars," or " thunderbolts," are constantly falling on the earth from space, but are generally turned into dust by friction with the atmosphere. This one, which fell at Williamette, Oregon, U.S.A., is of iron, weighs 15 tons, and is 10 feet in length by 5½ feet high. It is one of the largest known. It is riddled with depressions, several of which are large enough to hold a child.



(*E.N.A.*

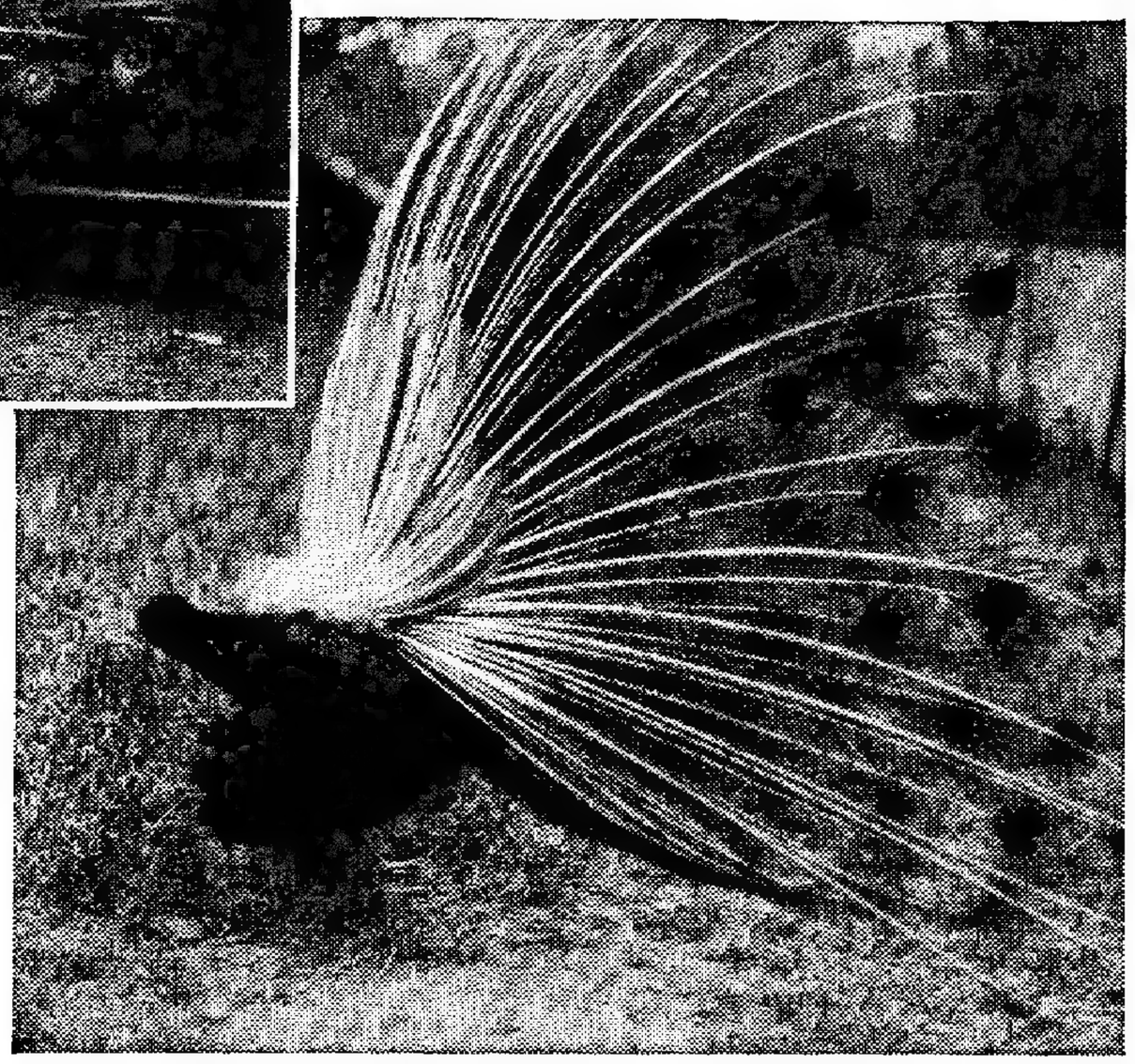
THE GREAT SHWAY DAGONE PAGODA, RANGOON.

This is one of the most venerated buildings in the East. It is of brick, lavishly gilded, and tapers up to a cone 300 feet above the ground.



Photos by [*W. S. Berridge.*

1. A PEACOCK IN FULL DISPLAY.
It will be noticed that the " eyes " are arranged on a definite and perfectly balanced scheme.



2. A back view showing how the tail coverts, like a fan, support the main feathers.

Wonderful Bird Plumage

WE remark upon the gay plumage of a few of the rarer British birds, such as the jay, magpie, green woodpecker, kingfisher and hoopoe, principally because they are exceptions to the rule. Most of our garden birds, such as the thrush, blackbird, hedge-sparrow, nightingale and wren, are rather dull fellows, in appearance at least, though the male chaffinch, the robin and the goldfinch are rather more pleasing. But abroad, and especially in the Tropics, many of the birds are really gorgeous creatures, as may be realized by some of the examples figured in our Colour Plate. In the almost continuous sunshine of the Tropics there are gay flowers and luxuriant vegetation, and the plumage of the birds is in keeping.

Apart from the greater splendour of tropical birds, we find that male birds are generally more striking and have more gorgeous plumage than the females. The cock pheasant is a good illustration, the hen pheasant being as sober in plumage as the partridge, both sexes of which are brown and quiet in tone.

[*W. S. Berridge.*

GREATER BIRD OF PARADISE.

orange-scarlet, with violet stripe, forehead golden green, neck black, and throat vivid lilac, while the rest of the body is chestnut and green. These pretty birds have a habit of hovering over bell flowers like large butterflies or moths, sipping honey with their tube-like bills and long tongues. When leaving one flower for another they have the power of flying backward.

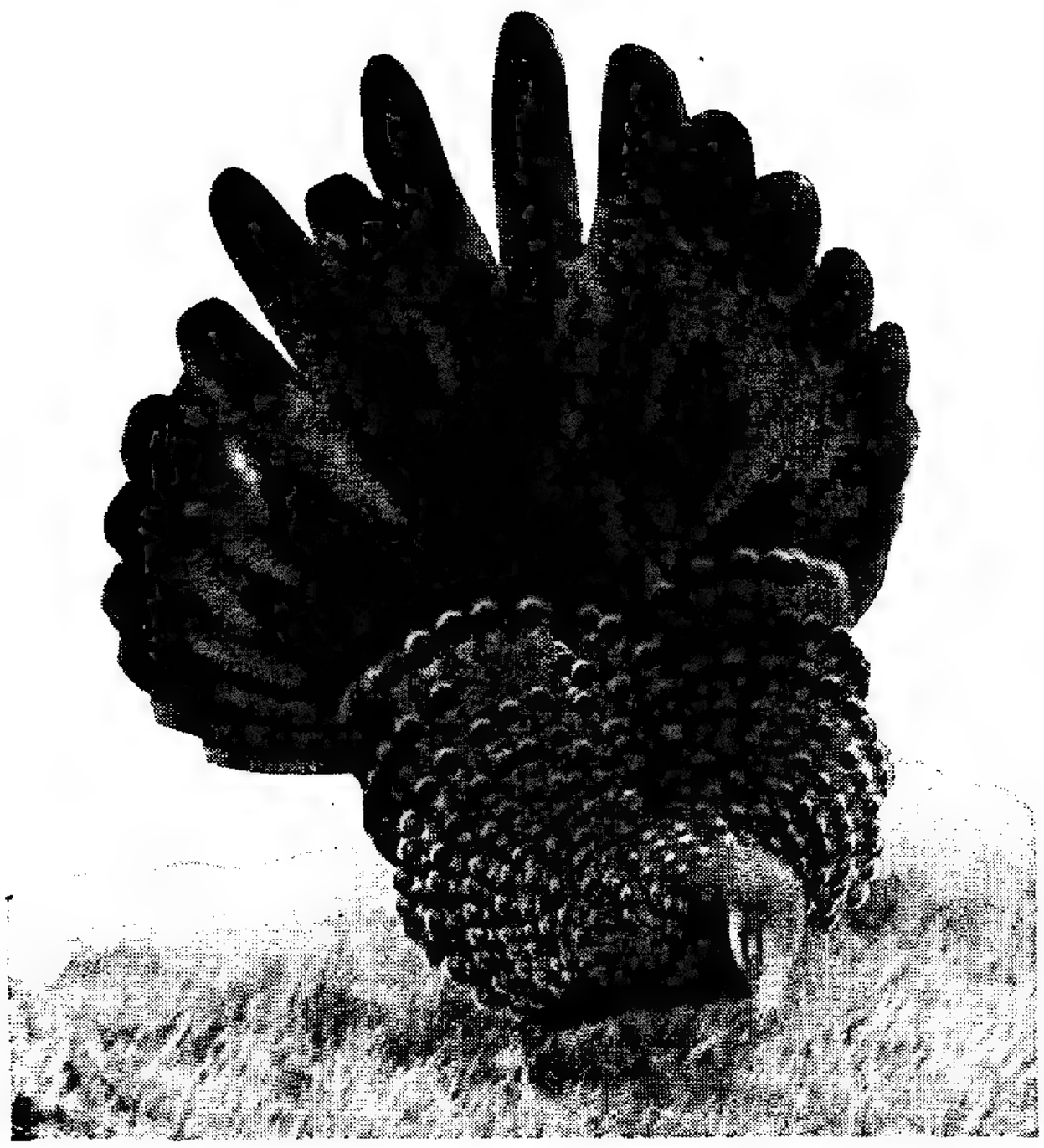
As resplendent, but larger and more striking, are the birds of paradise, natives of the East Indies, New Guinea and North Australia. Until public opinion

Among the groups of birds specially noteworthy for their brilliant colours are the humming birds. Many of these are quite small, only two and a half inches long; but others may be eight inches long, the larger ones being plainer in plumage. The males are especially gorgeous, their plumage being comparable with such gems as the sapphire, emerald, amethyst, topaz, ruby, etc. Among the most beautiful humming birds are some found in the West Indies and South America, which are golden-green, with blue chests and back. One kind in the Andes has blue wings with a black tip, and is dark green elsewhere. Rainbow tints are found in the rainbow humming bird, which has a crown of

[*Illustrations Bureau.*

SNOWY EGRET.

The cruel practice of using the beautiful plumage of these birds as "millinery" has fortunately almost died out.



[*W. S. Berridge.*

PEACOCK PHEASANT.

feathers round the head and neck, the with purple, chestnut-brown, and deep greens. It is the males as usual, that are so gorgeous ; many have "dancing grounds" where they show off their feathers to the greatest advantage, the females looking on with interest and admiration. Some, as the Great bird of paradise, perform on the branches of trees. This bird has magnificent plumes at the sides of the body, which gleam like gold when the bird quivers in its display. Some birds of paradise bear long wire-like pennons or plumes.

denounced the practice, their egret-like sprays might often be seen in many ladies' hats. Birds of paradise are really gorgeous crows. What is known as the Emperor William bird of paradise has side feathers of pure white, being elsewhere chocolate brown, straw-yellow, and deep beryl-green. The King of Saxony bird of paradise has long streamers of a most brilliant enamel blue, and twice as long as its body, standing out from the back of its head. The Superb bird of paradise has a brilliant emerald gorget, and a wide frill, or ruff, of rest of the plumage being black,

[*W. S. Berridge.*

THE OSTRICH SHOWS OFF.

The much-prized ostrich plumes are the white feathers of the male bird's wings and tail.

The hoopoe is a native of hot countries where there is much sand. Its buff tone and barred crest are less conspicuous there than in Great Britain, which it occasionally visits. When observed, the hoopoe seeks protection by throwing itself on the ground and ruffling its feathers so that it looks uncommonly like a piece of rag.

Perhaps next to the humming birds and birds of paradise the most beautiful group is that of the pheasants and their allies. The peacock is a familiar example, its long feathers, some 5 feet in length, rising not, as supposed, from the tail, but from the tail coverts on the back. The train, when spread out with the ocellate, or eye, spots at the tips of the feathers, forms a sort of circle round the neck, and is supported by the tail and wings. Quite as extraordinary is the display of the peacock pheasant, so called because both wings and tail have eye-like spots like those of the peacock itself.

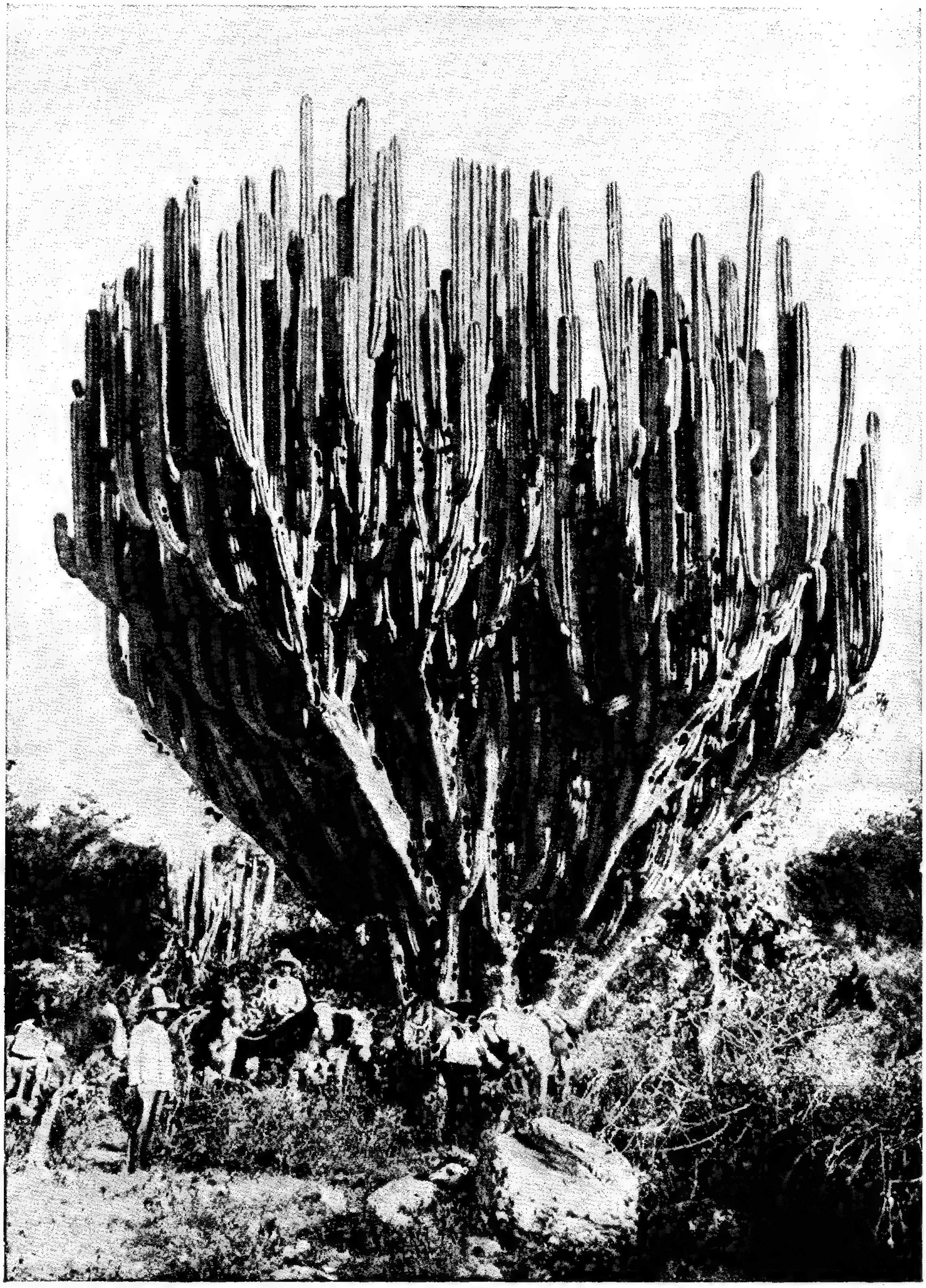
The chatterers and the cocks-of-the-rock are near relatives, both distinguished by very brilliant plumage.

In addition to the birds named, our Colour Plate shows several other beautiful specimens, some of which may be seen in Great Britain. Perhaps the favourite is the kingfisher, which haunts rivers and pools and is very shy, never giving more than a flashing glimpse of himself. There is a wonderful display of macaws of all colours at the Zoological Gardens, but their true homes are in warmer regions.

The reedling, or bearded tit, is a rare bird, but may occasionally be seen in Broadland and other parts where there are reed-lined lakes and streams. The beard from which its name is derived is not a beard at all, but a tuft of black feathers hanging between the eyes and the bill. The bird is generally a brilliant cinnamon colour, with a pearly grey head.

[*Photopress.*

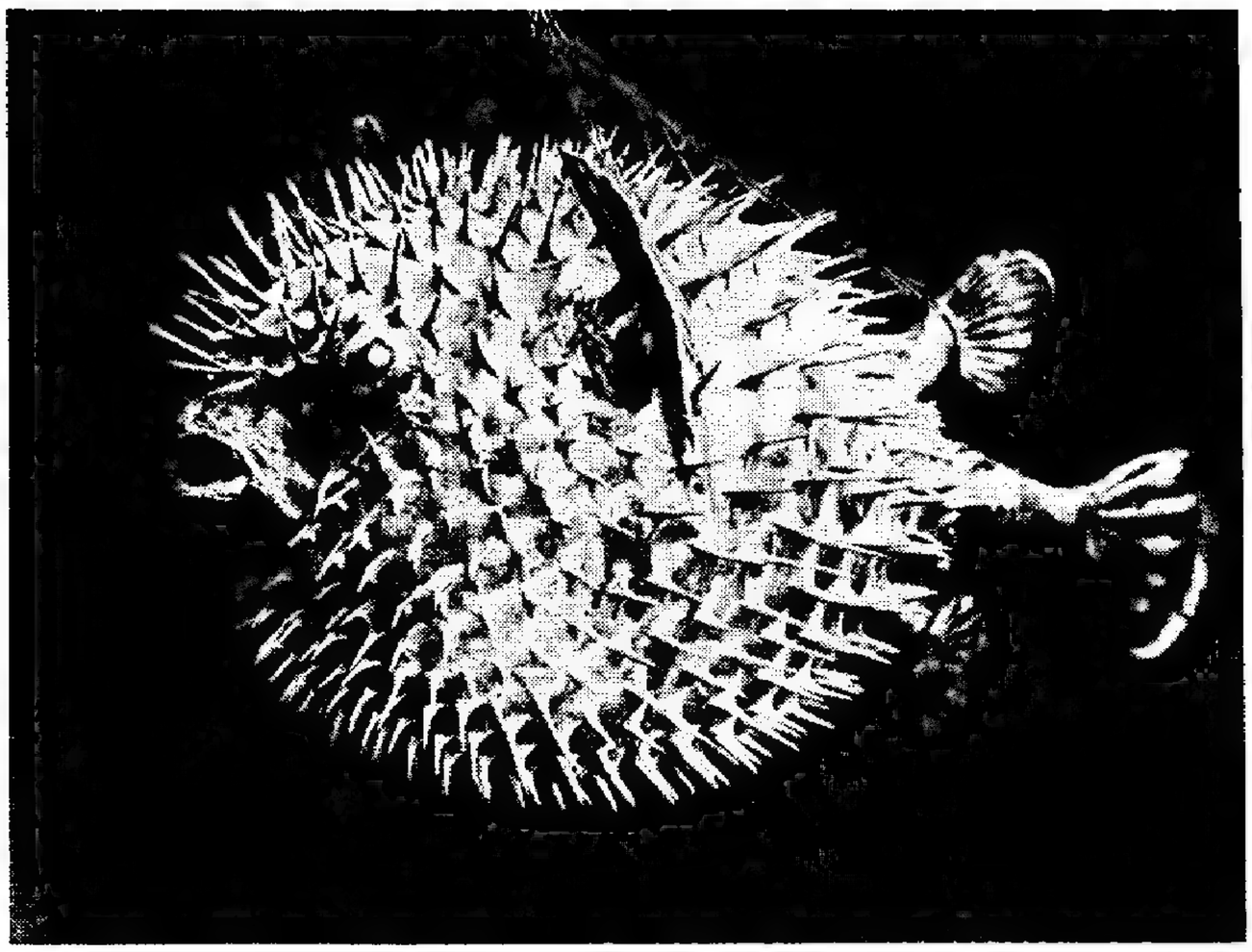
A MOTOR-CAR WHICH CAN BE DRIVEN EITHER ON LAND OR SEA.



[*E.N.A.*

A GIANT ORGANUS CACTUS, MEXICO.

Those who are only familiar with the ordinary greenhouse cacti find it hard to realise the great size attained by these plants in tropical countries. This one looks like a many-armed candelabra and towers high above the heads of the horsemen.



[*Topical.*

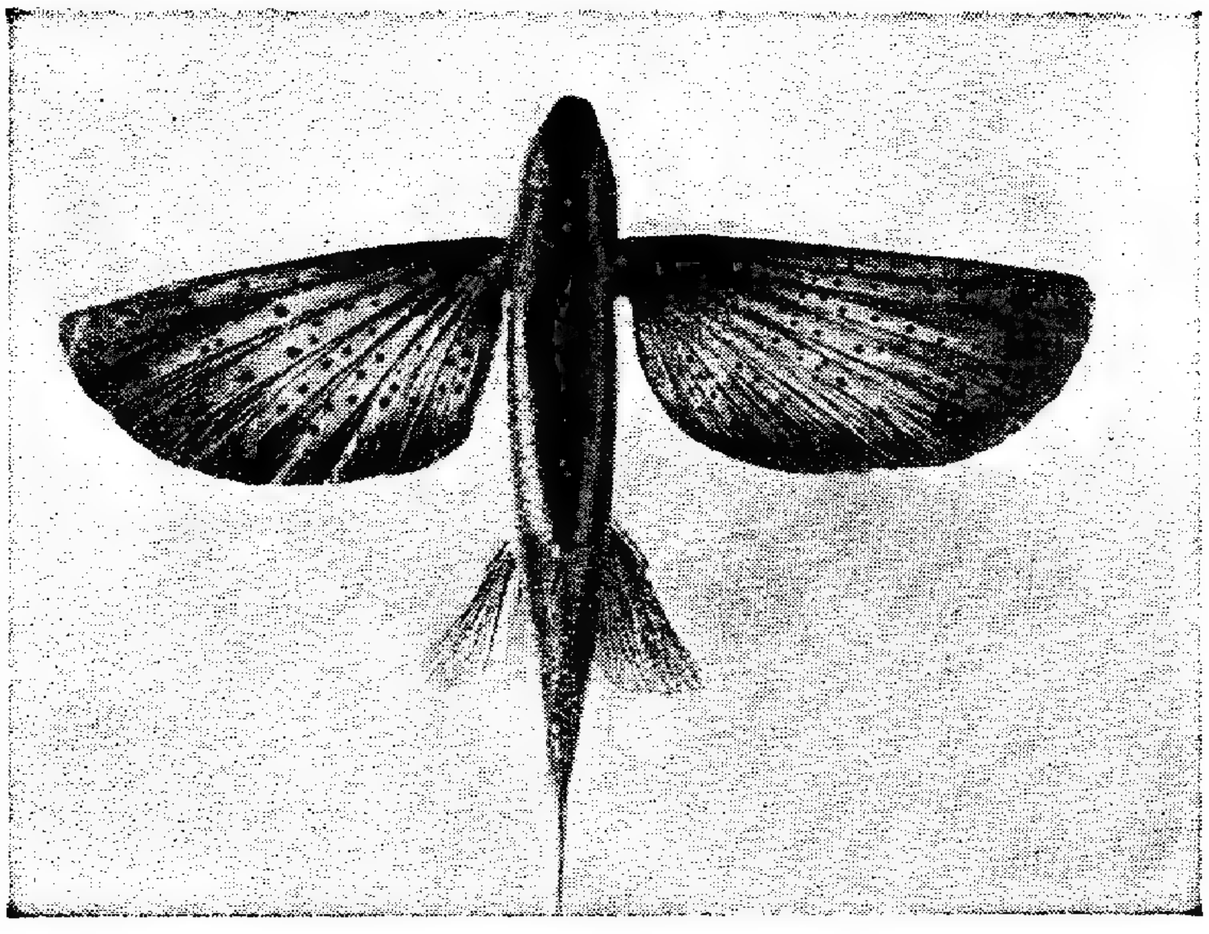
A PORCUPINE FISH FROM THE CARIBBEAN SEA.

The Unexpected in Nature

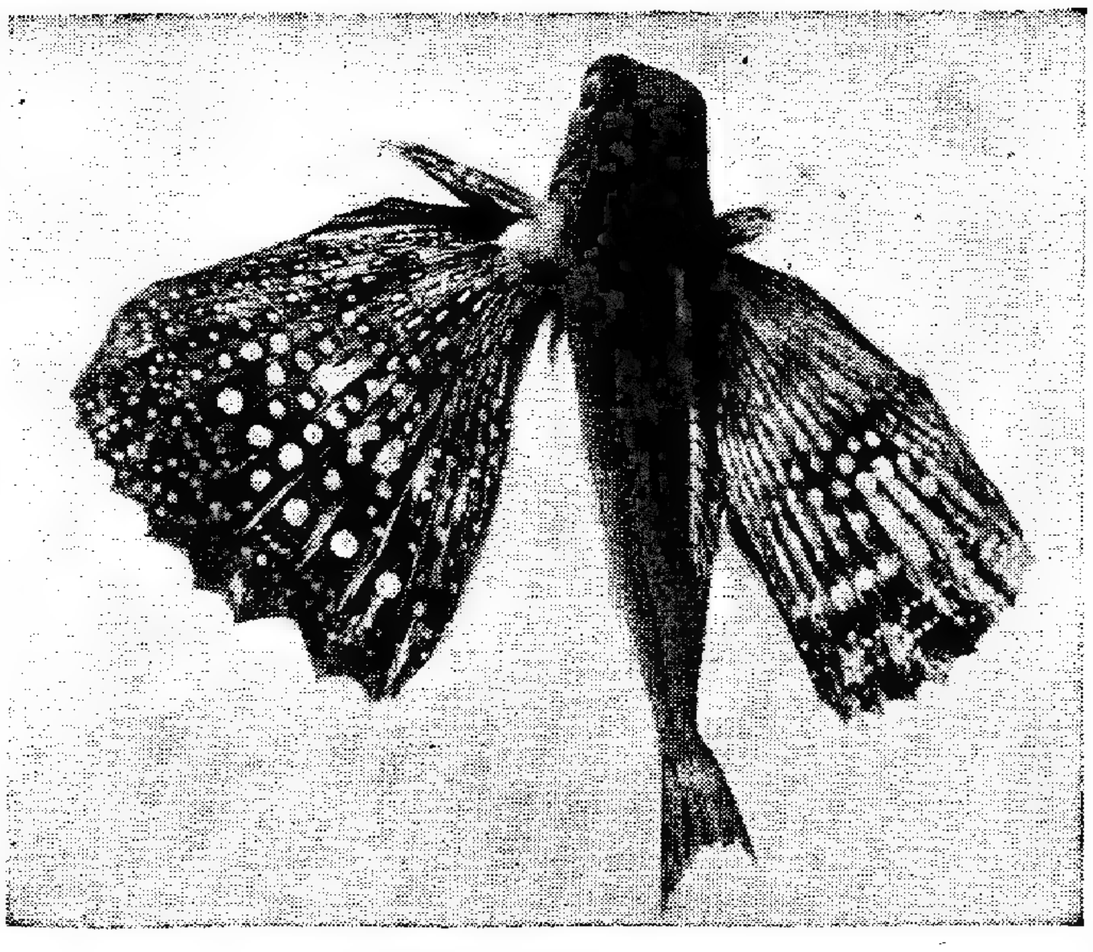
(Photographs by W. S. Berridge, F.Z.S.)

THERE are exceptions to every rule, and in spite of the maxim that "like produces like," there are fish that live out of water, animals that fly though their relatives are earthbound, others that make nests in trees, and some that lay eggs like birds. Let us give a few instances of these interesting "exceptions."

Flying fish are often seen by the ocean traveller as he "crosses the line" in the Tropics, off California, in the East Indies, or elsewhere. The habit of flying was doubtless adopted to avoid the attacks of

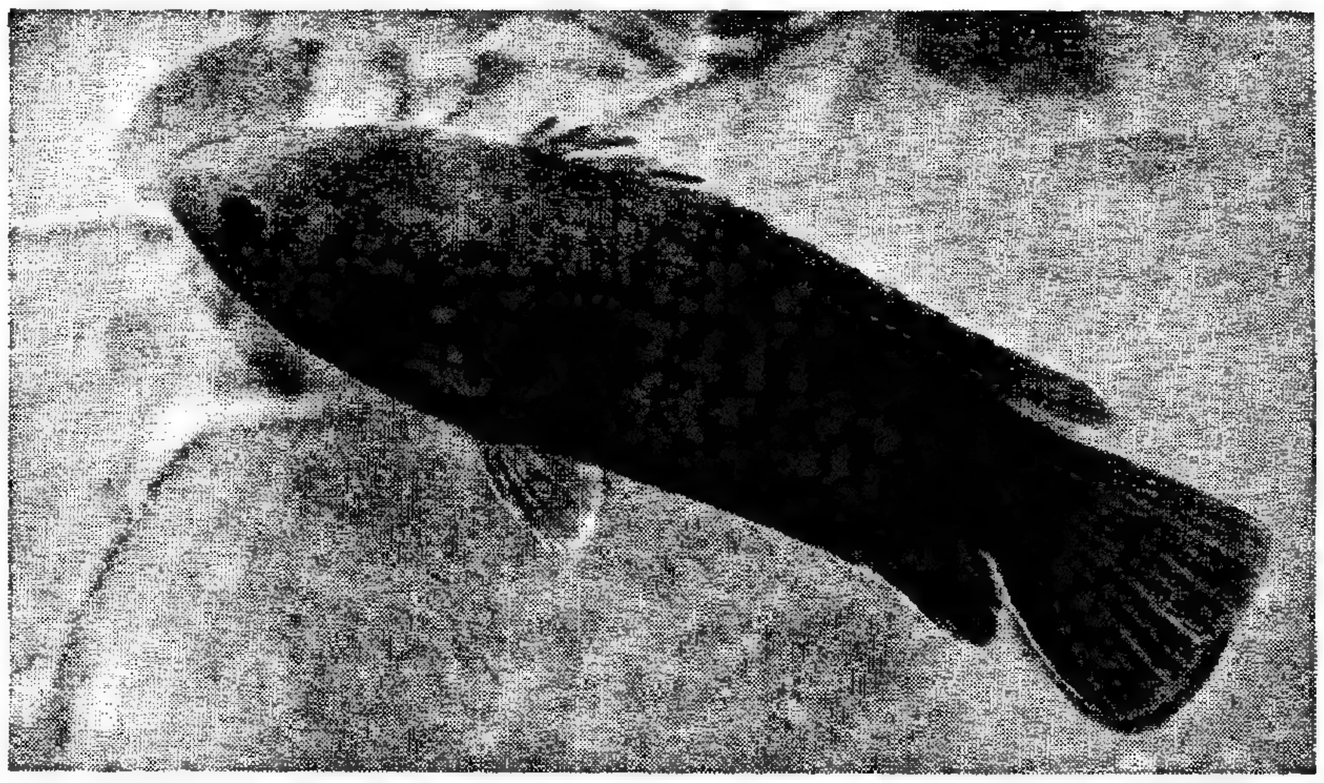


FLYING FISH.



FLYING GURNARD.

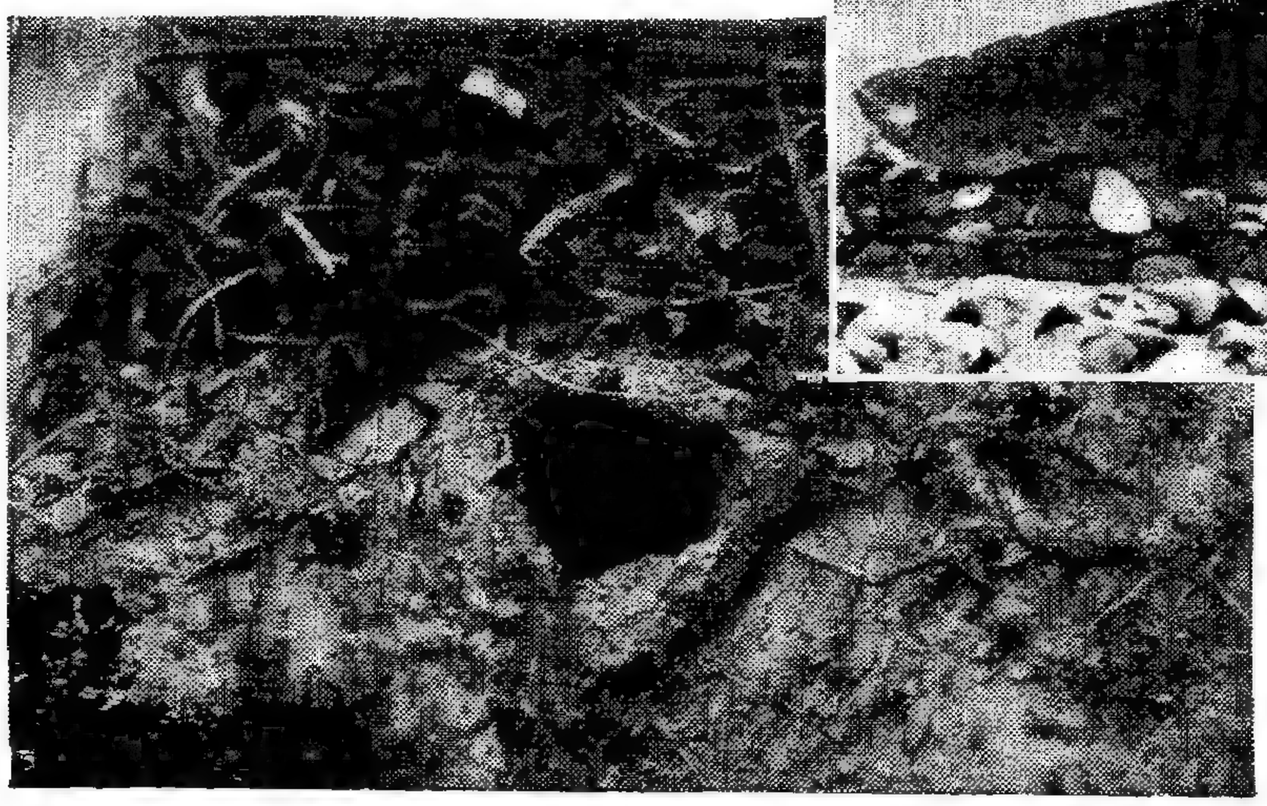
sharks and other enemies. The flying fish resembles a herring, except that its breast fins are much larger, and are like wings. The scales on the "wing" glisten like silver, and as shoals of the fish fly past a vessel they glitter like shimmering jewels.



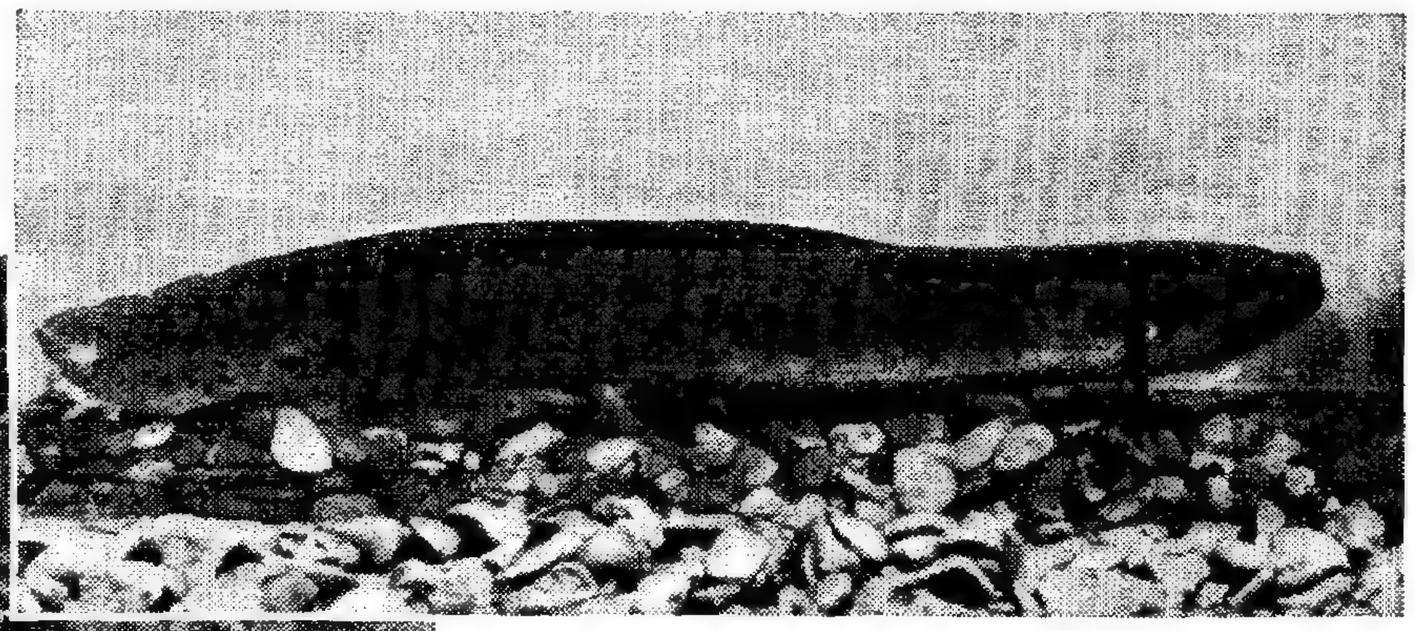
A FISH WHICH CLIMBS TREES.
The Anabas or Climbing Perch.

Other types are the butterfly-fish, which lives in fresh water, and is found in the Cameroons, the Victoria River and elsewhere. The flying dragon-fish has enlarged lateral fins, which give it the appearance of a miller's thumb. The flying gurnard has very large breast fins, and may be seen on the wing, or rather "fin," in Mediterranean waters.

Instead of taking to the air, some fish contrive, like frogs and toads, to live on land as well as in water. One is the mud-skipper, or walking-fish, so called because it spends more of its time on land. It is found in several West African rivers. The breast fins resemble frogs' feet, and the fish can climb up mangrove or screw-pine trunks. The climbing perch also ascends trees. There are also two kinds of mud-fishes, which, having lungs as well as gills, are able to exist out of water. One is the Queensland lung-fish, or Dawson River Salmon, which lives in weeds where there is little air and comes to the surface to breathe

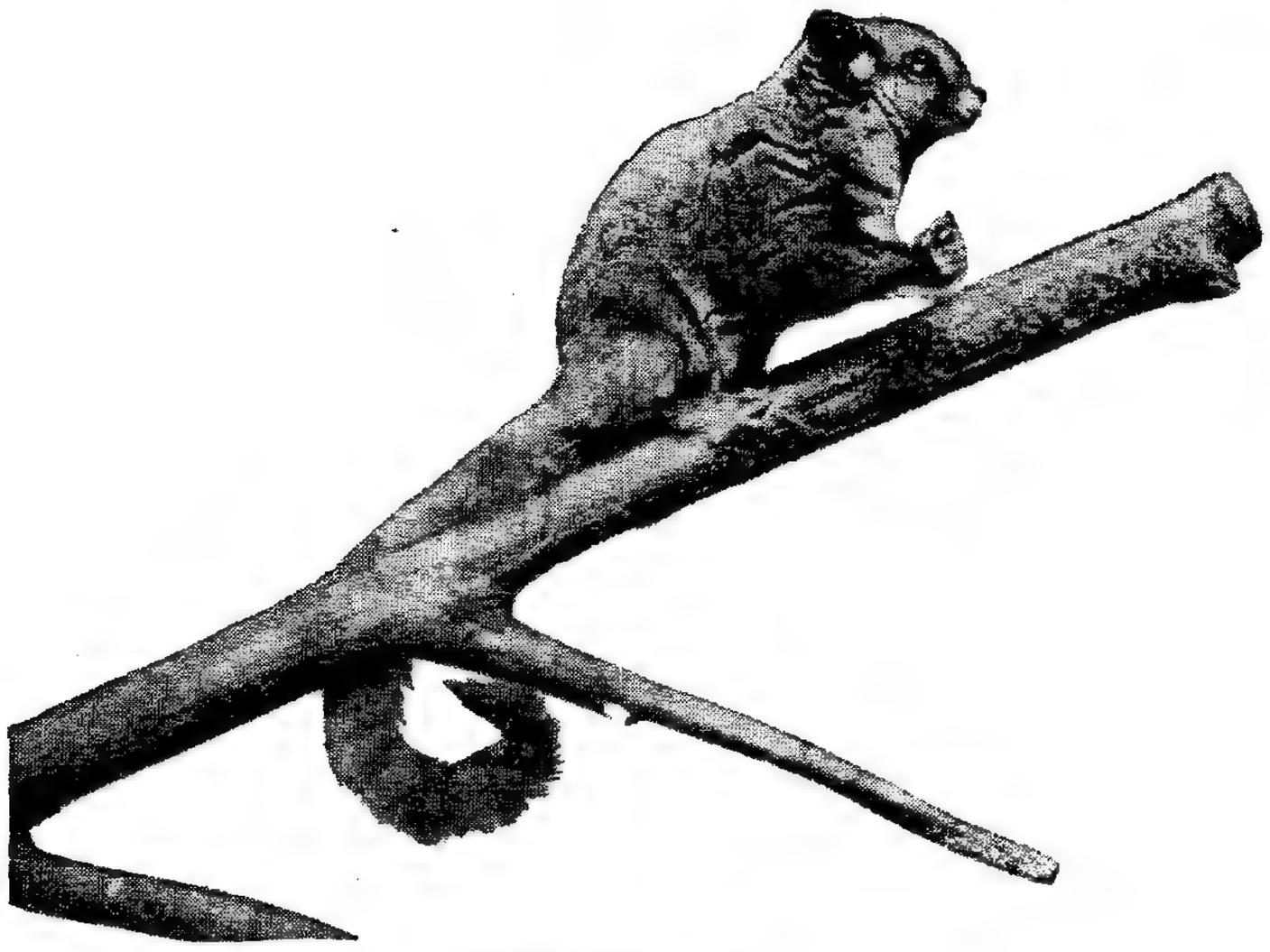


HOLE, OR NEST, OF THE MUD-FISH.



A FISH WITH LUNGS.

The African Mud-Fish can not only breathe oxygen by its gills, but has lungs, which enable it to breathe when the dry season comes and the rivers disappear.



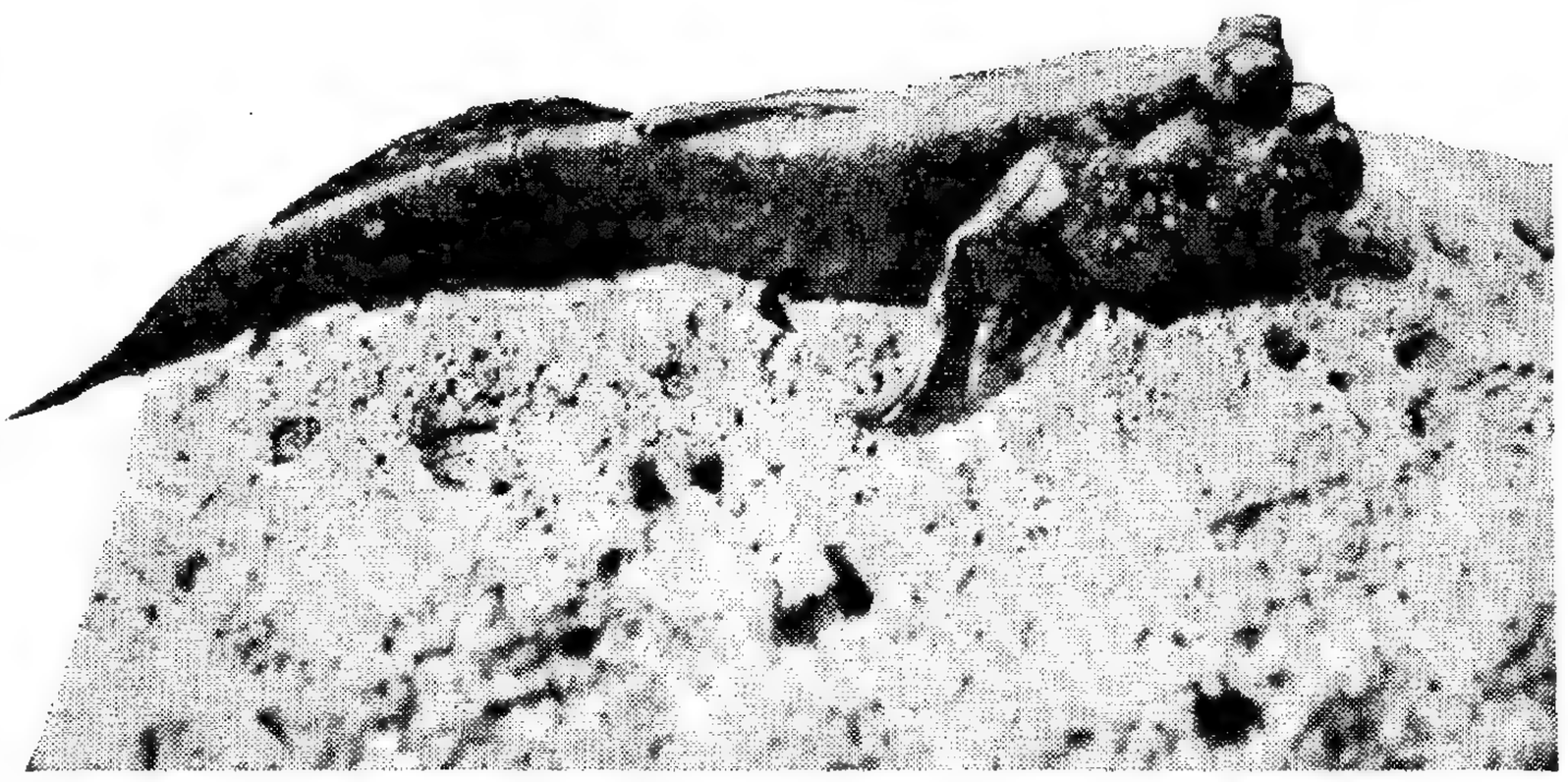
FLYING PHALANGER.

tails, adapted to flying. Among lizards the flying gecko has flaps along the ribs, serving as parachutes, and the tail is rudder-like. The flying frog has enormously expanded webs to its feet. The British squirrel can leap from branch to branch, but there is an American squirrel that can fly as well as leap.

As every boy knows, bats can fly. The huge flying fox, or fruit bat, hangs

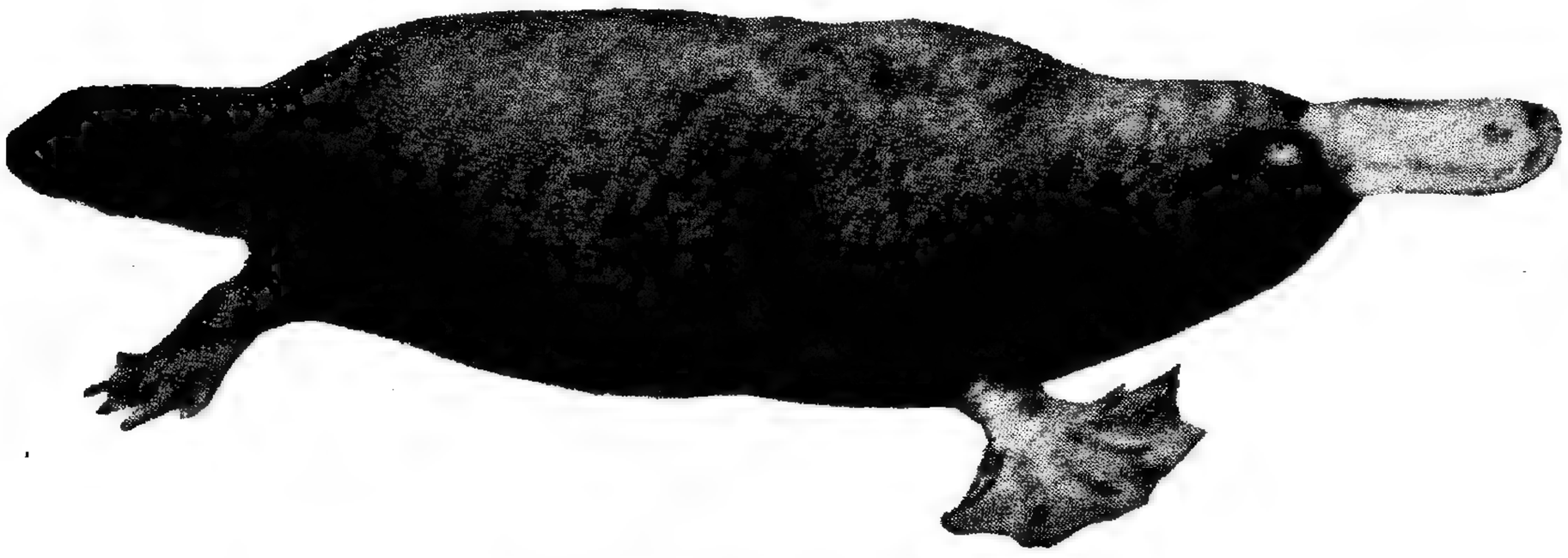
with its lungs. The African mud-fish also has lungs, enabling it to breathe when the dry season comes and the rivers dry up. It buries itself in mud till the rivers fill again in the wet season.

Most four-footed animals, whether reptiles or mammals, live on the earth, but a few have their forelegs, or feet, or



WALKING-FISH, OR MUD-SKIPPER.

This is truly a "fish out of water," for it spends more time out of water than in it, and if placed in deep water is quickly drowned! It climbs roots and banks by means of the breast fins. The walking-fish is a member of the Goby family, and is common in the rivers of West Africa and Burmah.



THE PLATYPUS, OR DUCK-BILL.

We expect birds to lay eggs, but it is a surprise to find that mammals also may. The platypus, of Australia, is one of the few. Its eggs are laid in a long burrow by the side of a stream. The duck-like bill is used for shovelling and boring.

A FLYING FROG.

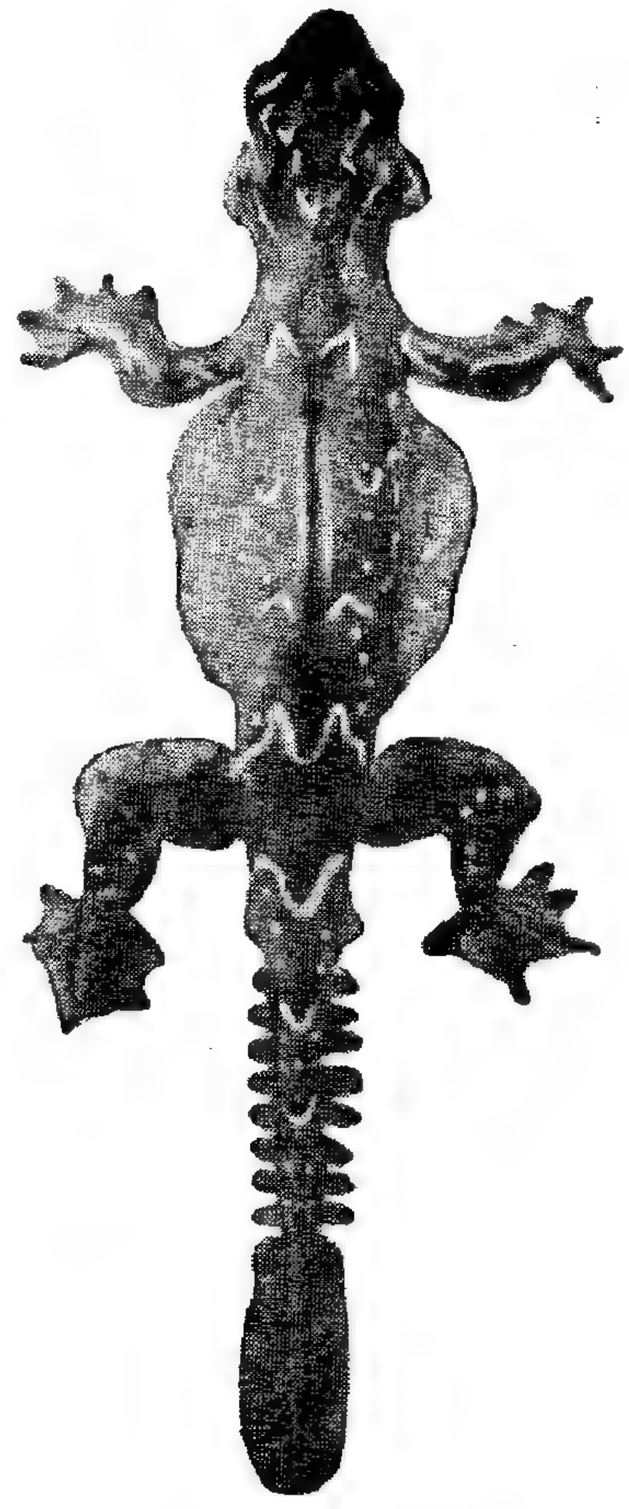
Flight is accomplished by means of the greatly expanded webs to the feet, which sometimes cover three times as much space as the body.

below a branch with its hind feet. Its wing expanse is tremendous. So many settle on the trees of rubber plantations in Ceylon that they weigh down the branches.

In Australia there are flying squirrels, having floats at the sides, which enable them to fly from tree to tree. The flying opossum, another native of Australia, is also able by a parachute-like extension of skin on the ribs to fly.

One would be surprised to find an actual mare's nest with eggs. But there are several mammals that lay eggs. The platypus of Australia and Tasmania, with a duck-like bill, is the most remarkable instance. The nest, made near rivers, is underground and has two entrances; it may contain from one to three eggs. The echidna, or ant-eating porcupine, is another egg-laying creature found in Australia and Papua; its young are carried about in a pouch. Another egg-layer is the proechidna, an ant-eating creature like the echidna, but more like the true ant-eaters in appearance.

Lastly, we may note how mammals in a few cases depart from the general custom of making their lairs on the ground, by building nests in trees or elsewhere. The orang-utan is a regular nest-builder in its native forests in Sumatra and Borneo, using a platform of sticks for sleeping purposes. One orang-utan that escaped at the Zoo built a nest in the gardens overnight. The gorilla makes a family shelter in trees, and a special one when a baby is born.



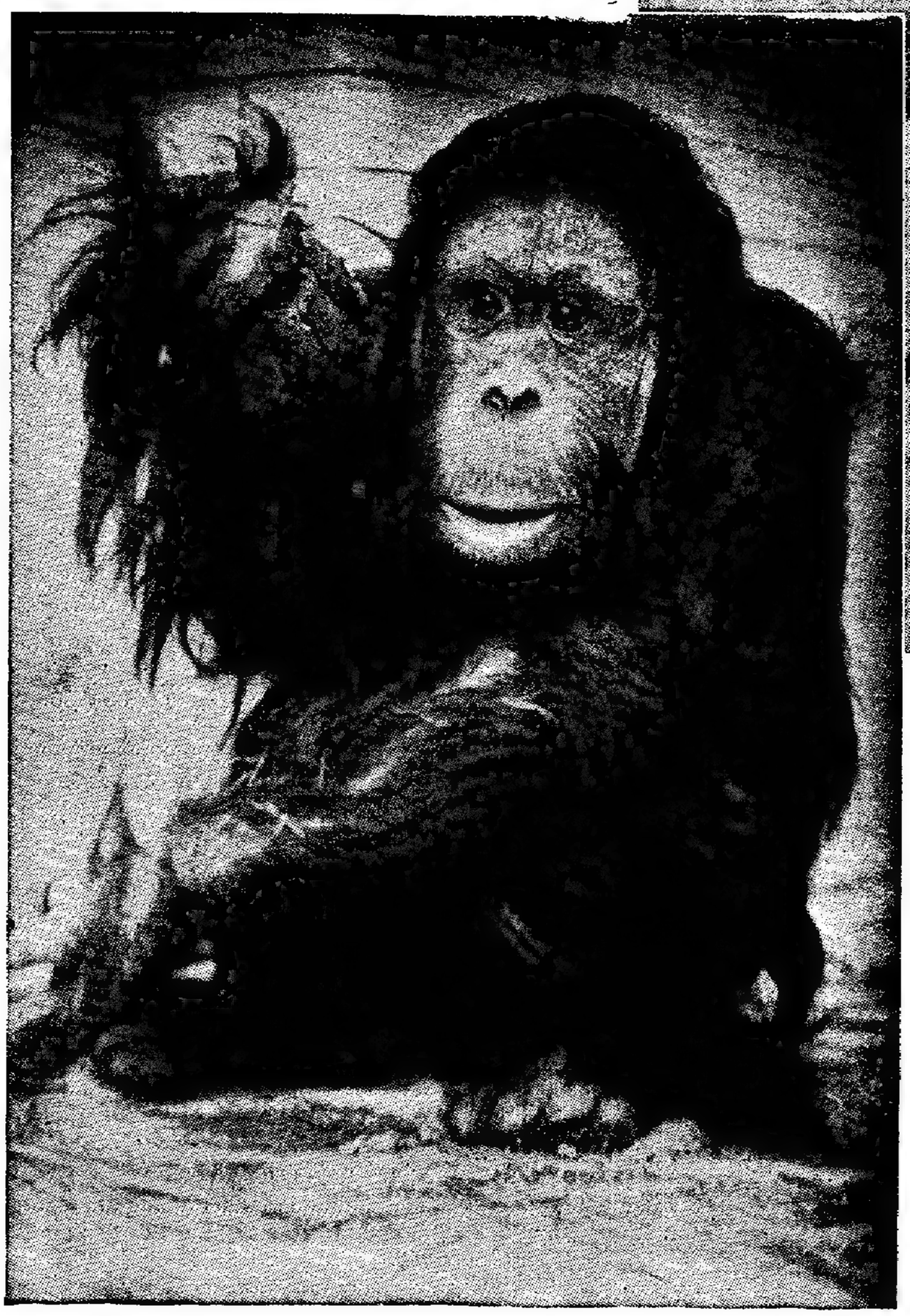
A FLYING GECKO.

The Geckos belong to the Lizard family and are among the quaintest of creatures. The Flying Gecko has flaps along the ribs, serving as parachutes, while the tail makes an excellent rudder. To evade capture geckos and other lizards will sometimes "leave their tails behind them." It doesn't matter much because another one soon sprouts out.

The male chimpanzee makes a family nest in a tree, and sleeps under the shelter, on guard.

Certain lemurs found in Madagascar make a nest a foot in diameter, and may, like the British dormouse, make two types of nests, one for sleeping and one for storing grain. The Aye-aye also lives in the bamboo jungles of Madagascar, feeding on insects, and constructing a nest to sleep in. The Canadian jumping mouse and the harvest mouse are examples of mice which make nests above ground, as their allies, the house mouse and the rat, do underground.

CHIMPANZEE.



ORANG-UTAN.

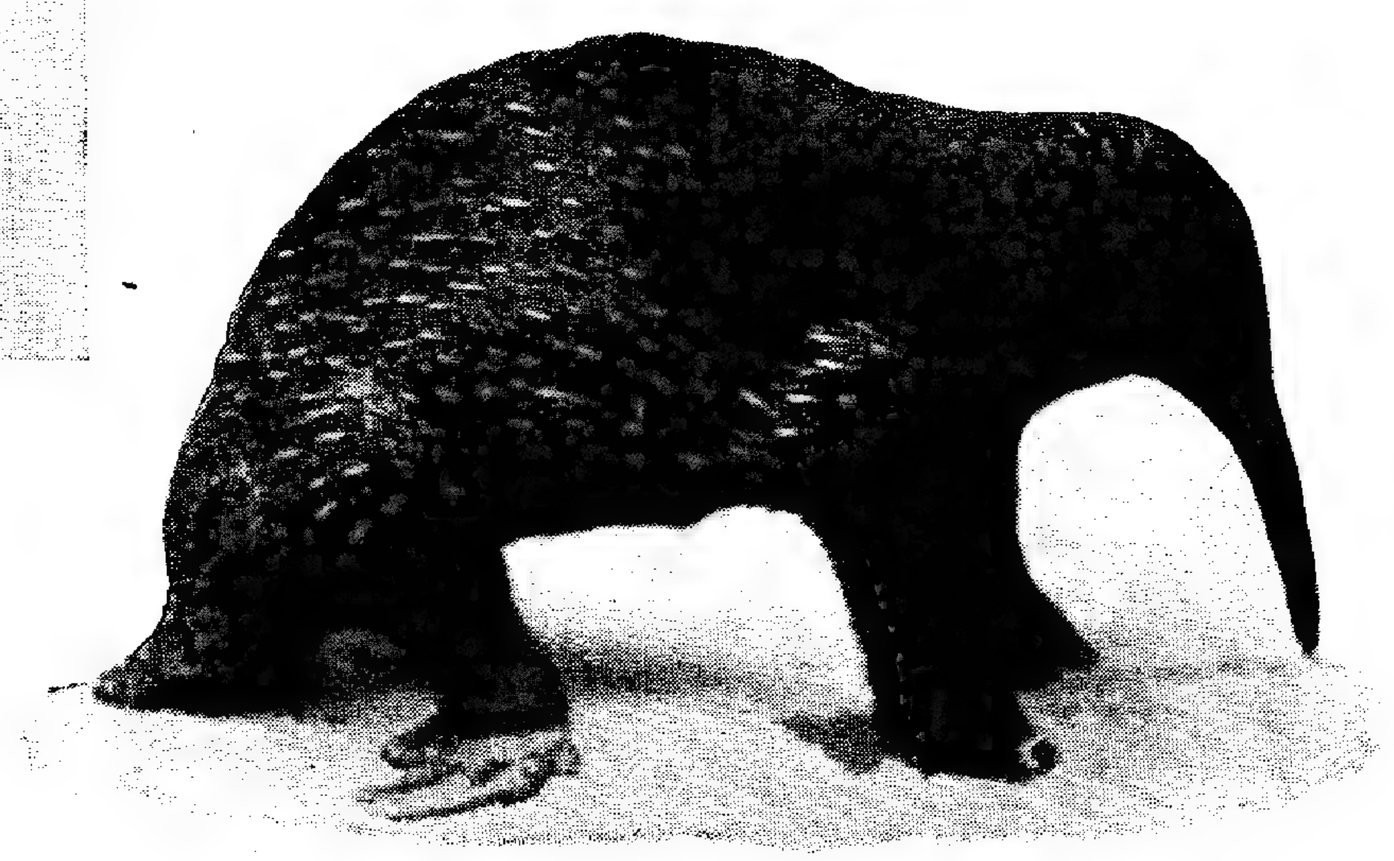
Two animal nest-builders.

Enough has been said to show that Nature's ways are more varied than we sometimes think, and that she has a wonderful power of adapting her creatures to their needs and surroundings.

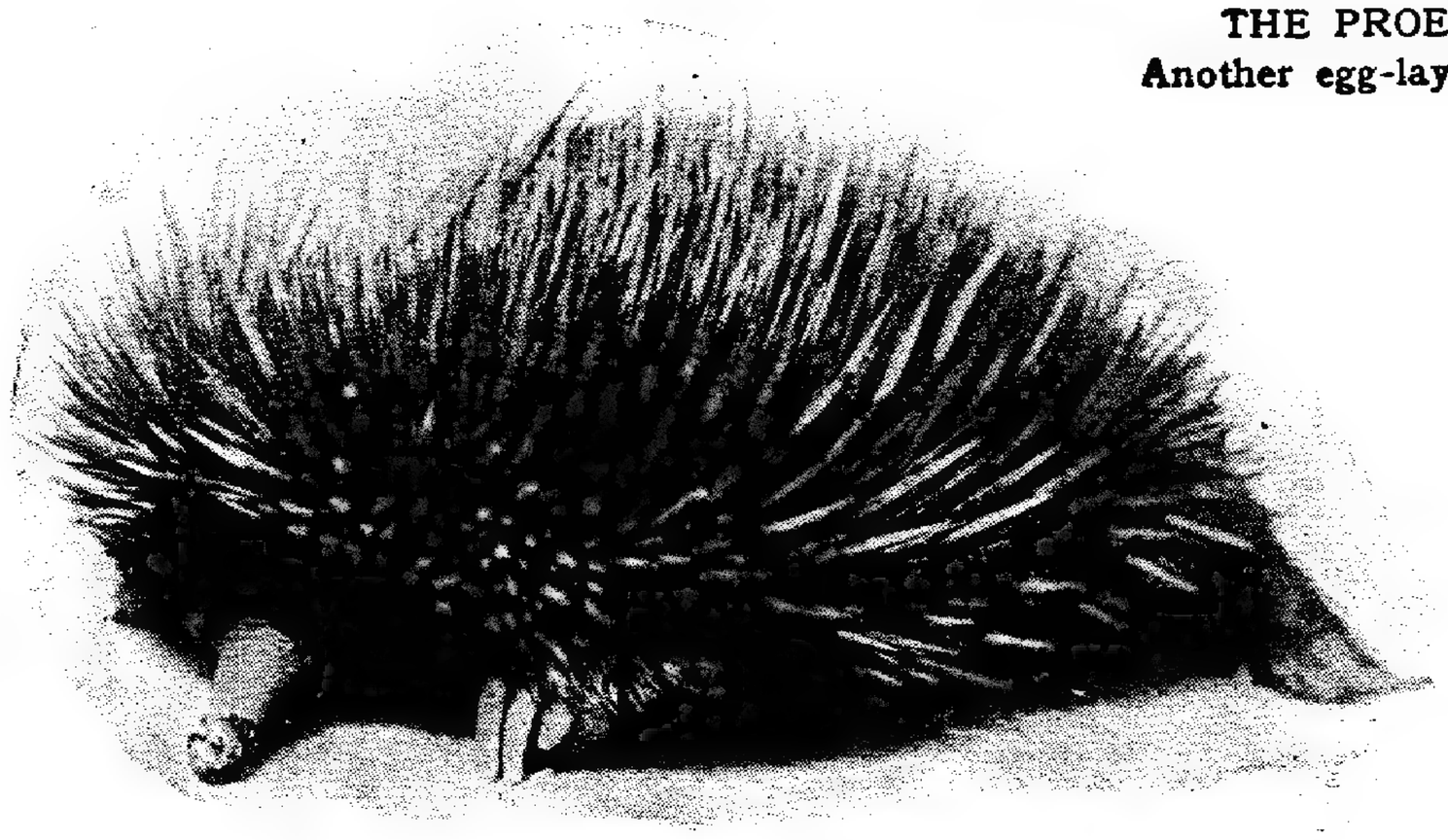
A. R. HORWOOD.

A FLYING FOX.
(Indian Fruit Bat).

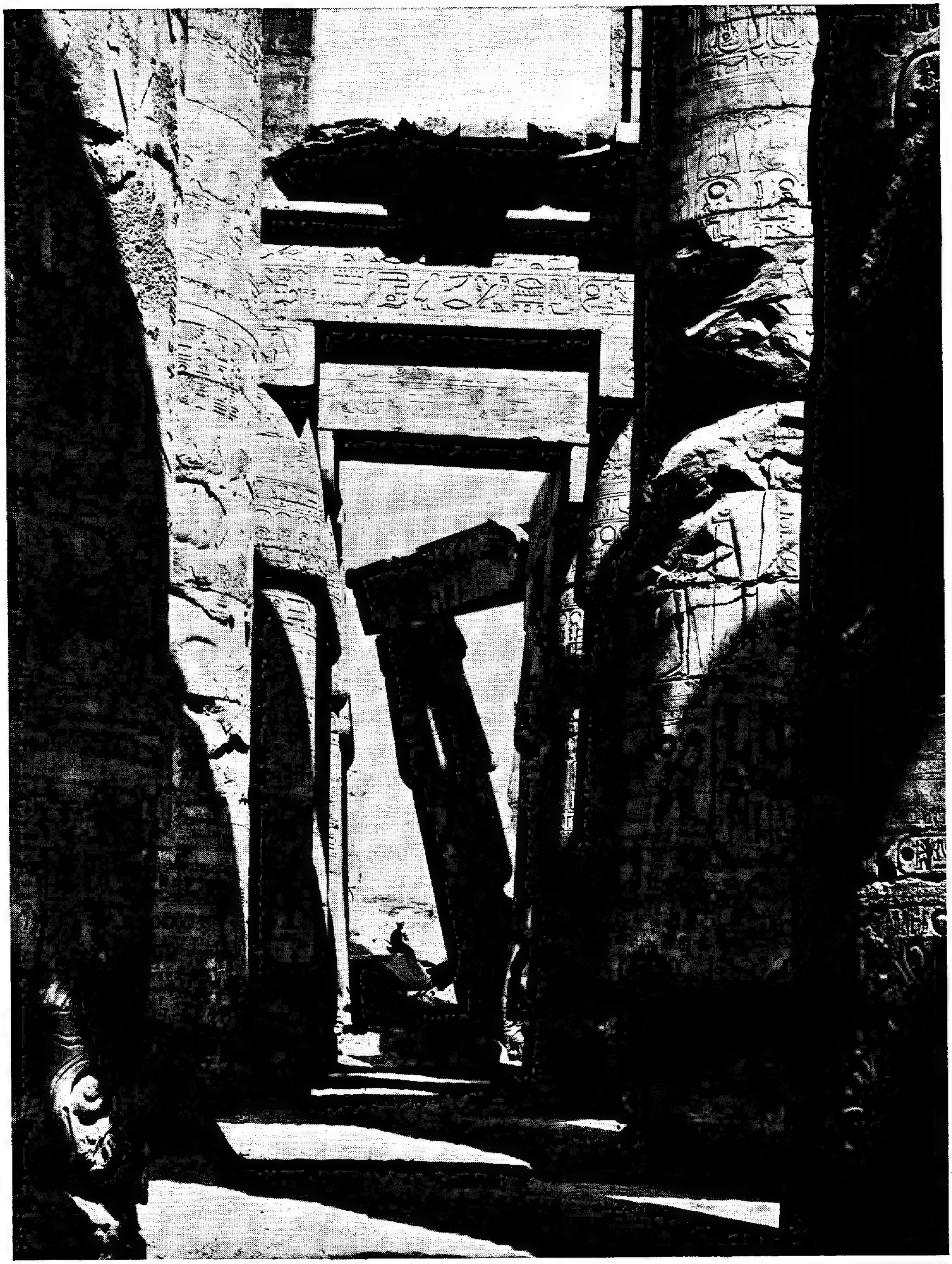
NEST BUILT IN A TREE BY AN ORANG-UTAN.



THE PROECHIDNA.
Another egg-laying mammal.



THE SPINY ECHIDNA, OR PORCUPINE ANT-EATER.
One of the very few egg-laying mammals.



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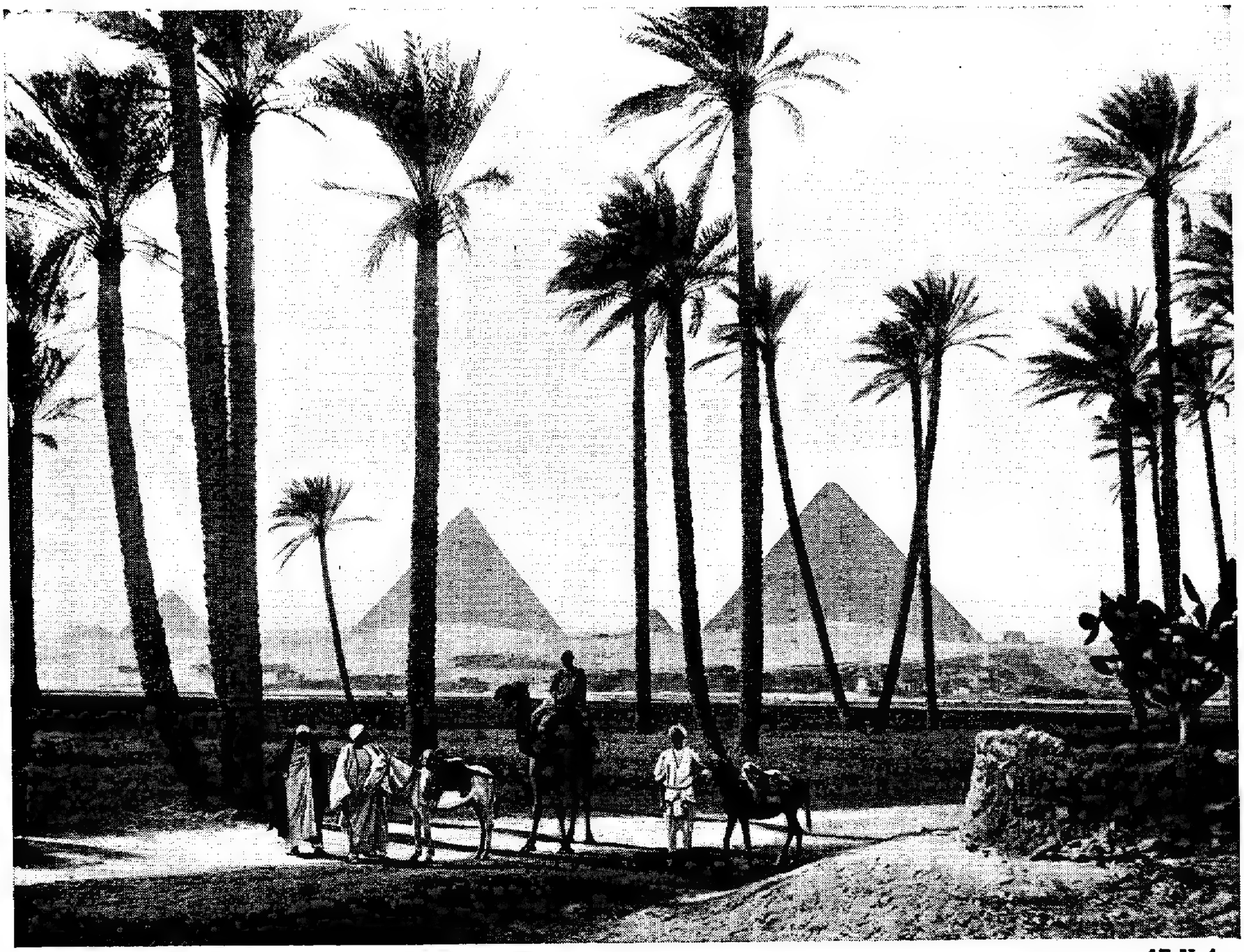
THE TEMPLE OF KARNAK, EGYPT.

The photograph shows some of the great carved pillars, said to be the biggest ever employed in the interior of a building, and the famous leaning column.



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THE PYRAMIDS OF GIZEH.

The Wonders of Ancient Egypt

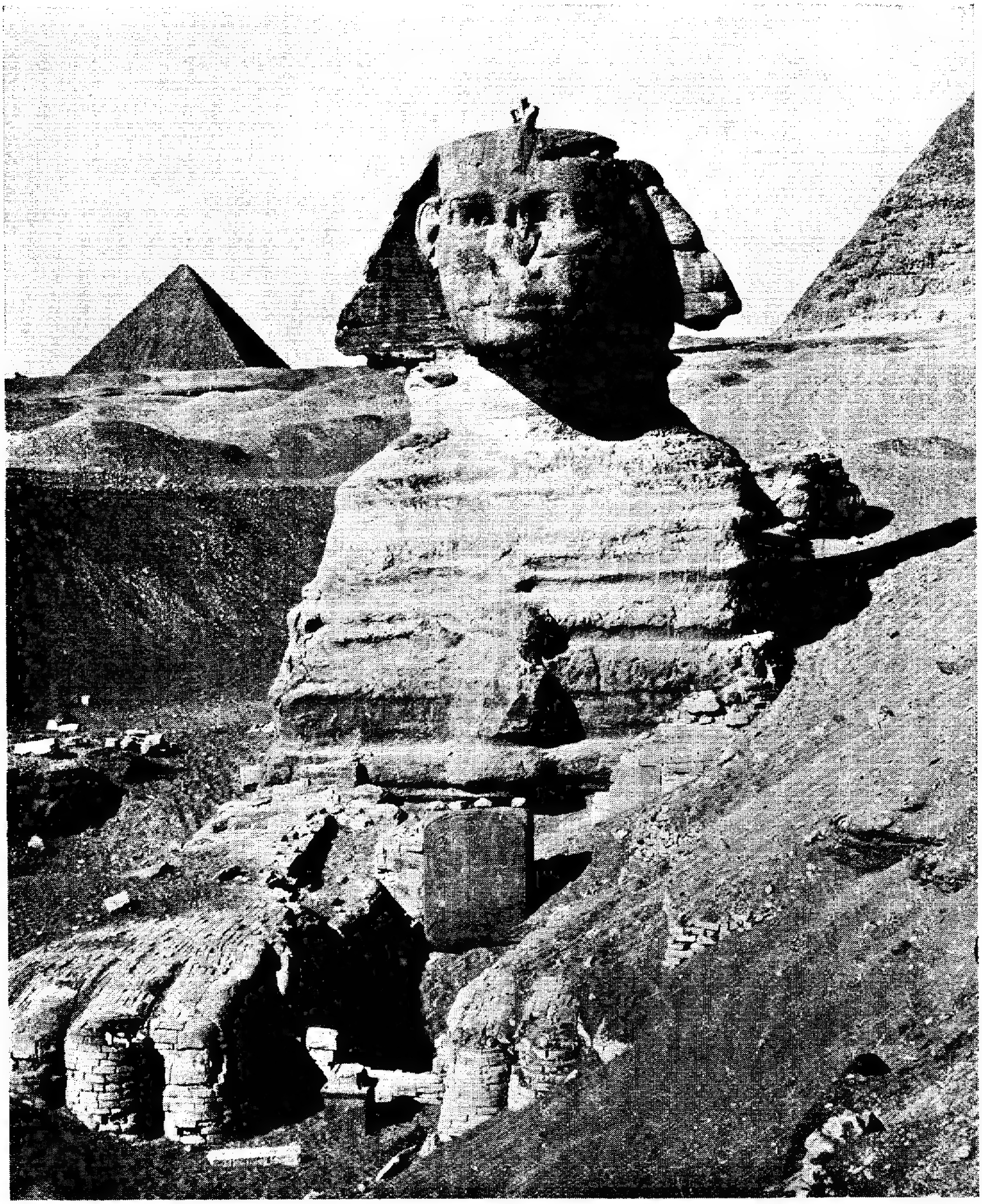
THE Land of the Pharaohs! That phrase, well-worn though it is, conjures up more swiftly, perhaps, than could any other the scenery and the details of some of the most wonderful stories that have ever been told. There is nothing in any history or any novel to surpass in vividness and interest the Bible tales of Joseph and his brethren and of Moses, and to both stories the name of Pharaoh furnishes a sort of key-word, bringing up not only the little points—and what beautiful little points they are!—of those simple chapters of history, but also something of the grandeur of Old Egypt, the insolent magnificence of her early kings, and the prosperity of her people, then, as now, drawing most of their sustenance from the fertilizing river Nile.

Allusion is made in the chapter entitled "Wonder Workers of Long Ago" to the early civilization of Egypt. Here let us say a few

words about the more remarkable buildings and monuments which have come down to us—some of them in a wonderful state of preservation—from those far-off times. But first we must glance at a very remarkable feature of prehistoric Egyptian life which we find illustrated over and over again in Egyptian tombs, wall paintings, and inscriptions dating back to more than 4,000 years before Christ. This is the curious belief that every man is born with a "ka," or double, which survives after death, and ought, if possible, to be provided for. Thus, in the burial chamber of a great man Egyptians would place jars, weapons, mirrors, and even chairs, musical instruments, and wigs for the use of "ka"; and when on the walls of a tomb we find pictures or carvings of servants engaged in brewing, baking, and so on, they are supposed to be performing those services for the dead man's "ka" in the other world. The ruler and judge of the dead was the greatest of the Egyptian gods, Osiris, and in one famous painting on papyrus which has come down to us through the ages a judgment scene is depicted in which before Osiris there stands a great balance. In the balance the heart of a man is being weighed against Truth, and behind Osiris stands another god, Thoth, ready to register the result.

With a people for whom death and what follows had such an intense meaning, even in those primitive times, it was natural that most, if not all, of their monumental buildings should take the form either of great tombs or memorial temples and obelisks. The use of stone for building in Egypt goes back to about 5000 B.C., but masonry did not become a real art until about 1,000 years later, when we find it in a wonderfully advanced state under Cheops, the builder of the Great Pyramid. From the very earliest times the Egyptians possessed a number of builders' and other tools, the adze for dressing blocks of limestone, the brick-mould, the mud-rake for mixing plaster, and the square and plummet. Of carpenters' tools, mallets, hammers, knives, chisels, scrapers, saws, and borers, they had a still greater variety, and they knew very well indeed how to use them.

The Pyramids have so often been described that only a brief mention of them need be made here. These huge erections were simply monuments of masonry raised over the burial chambers of the kings, the chambers being hollowed out of the rocky ground, and the building of the pyramid begun during the king's lifetime. The finest pyramids are those of Gizeh, on the edge of the Libyan Desert, near Memphis, on the west bank of the Nile. The biggest of them all is



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THE GREAT SPHINX.

Even in its worn and mutilated state the Sphinx has a dignity that impresses the most casual sightseer. It is carved out of a spur of rock and is probably about the same age as the Pyramids.

the Great Pyramid of Chifu, or Cheops, who flourished probably about 4000 B.C. It was originally taller than St. Paul's Cathedral and, according to the Greek historian Herodotus, 100,000 men were employed on it for thirty years. Some idea of the tremendous amount of work involved in the construction of this massive memorial may be gathered from the fact that for roofing the burial chamber fifty-six huge granite blocks, cut from the water-worn rocks at the Nile Cataract, were used, and these blocks have an average weight of 54 tons each!

About a quarter of a mile to the south-east of the Great Pyramid is the singular monument known as the Sphinx, a colossal form hewn out of the solid rock and probably intended to represent the guardian of a great royal cemetery in which the Pyramids were the memorial tombstones. The Sphinx is nearly 60 feet high, and is of such vast proportions that it contains a chapel and several staircases, one of them having thirty steps. Sphinxes, sometimes arranged in avenues, are to be found elsewhere in Egypt, but the Great Sphinx of Gizeh is the largest of them, and for centuries has been one of the sights of Egypt.

Most Londoners are familiar with the obelisk known as Cleopatra's Needle, the later adventures of which are described in our article "London's Most Ancient Monument." There is something a little bewildering in the

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TOURISTS CLIMBING THE GREAT PYRAMID OF CHEOPS.

At close quarters the sides of the Pyramid are far indeed from possessing the smoothness they present at a distance.

thought that this hoary relic of the old Egypt of Genesis, at which Moses quite probably gazed, should have been transplanted to this country and have survived to suffer slight damage during the air attacks upon London in the Great War!

Among the most celebrated and impressive of Egyptian monuments are two huge figures which rise in solitary grandeur out of a

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THE STATUES OF MEMNON, THEBES.

plain, and are known as the Statues of Memnon. They are really statues of King Amenophis III, who reigned about 1500 B.C., and are supposed formerly to have fronted a temple erected by the same monarch. In autumn the plain in which the Statues of Memnon stand is flooded, and a wonderful spectacle is presented at sunset by these colossal figures set in a waste of waters and agleam with orange light.

Of the Egyptian temples the vastest is that of Karnak at Thebes, the approach to which is a broad-paved road nearly a mile long, flanked by sphinxes, of which there must originally have been over a thousand. In front of the temple are six giant statues of the king under whom it was erected, and inside is a magnificent hall which formerly possessed a ceiling, but is now open to the sky. The massive columns supporting it remain, and are said to be the biggest columns ever employed in the interior of a building. There are 134 of them, and the tallest are about 70 feet high. Westminster Abbey itself does not cover as much space as is occupied by this mighty hall, from which there is a passage into an inner temple containing a sanctuary. The temple of Karnak is connected by avenues of sphinxes with the neighbouring temple of Luxor and with others.

Another beautiful temple, but of a later date, is that on the island of Philæ, in the Nile, near Assouan. This is dedicated to Isis, and was erected mostly by Roman emperors, but there are parts of it dating back to the fourth century before Christ. An interesting circumstance connected with this building is that in the year 577 it was converted into a Christian church.

In thinking of the older Egyptian temples, such as those of Karnak and Luxor, we must be careful to remember that they were not places of public worship, like the Greek and Roman temples, the mosques of Islam, and our Christian churches. The Egyptian temple was itself a monument set up by a king in order to earn the favour of the gods, and only the king and the priests were supposed to enter it. It has been described as a sort of "royal oratory," and it is noticeable that the temple of Karnak, vast as it was, was surrounded by high walls of unbaked brick which entirely concealed it from the public gaze.

Such and so various are the relics of bygone ages still lingering in this strange country. Egypt in recent years has entered upon a new chapter of its history by becoming an independent State, with an up-to-date system of government. But its monuments link it with a venerable past, and help us to realize that it is the Egypt which Abraham visited, in which Joseph rose to honour as a sort of Grand Vizier to Pharaoh, and from which Moses and his countrymen went forth across the Sinai Desert to seek the Promised Land.

OWEN WHEELER.

THE WONDERFUL FACE IN THE DESERT.

For thousands of years the great Sphinx at Gizeh has been one of the world's wonders. Worn and mutilated though it is, no traveller can gaze on that majestic face unmoved.

Photo by] [*Lick Observatory.*

GIANT SPIRAL NEBULA IN *CANES VENATICI* (THE "HUNTING DOGS").

The spiral form will remind boys of the familiar firework known as a Catherine-wheel.

Some Wonders of the Heavens

THE wonders of the heavens are so many and so great as to be quite beyond our powers of comprehension or imagination. The stars, gigantic suns; the *nebulæ*, fantastically-shaped clouds of gas; the comets, with their long and sweeping tails—all are so wonderful that whole books would be required to tell even the little we know about them. In the space at our disposal it is only possible to mention a few of the more interesting facts.

Everyone knows that the stars are really great suns, but so far away that they appear to us only as points of light, just as our own Sun would appear if we were able to journey into space on a voyage lasting thousands of years. Perhaps many of the stars have planets revolving round them as has our Sun, but this we cannot tell, their distances being so great.

Star distances are so enormous that they cannot be measured in "miles." Astronomers therefore express them by the velocity of light. A wave of light travels at the rate of 186,000 miles per second.

Thus it would pass around the earth seven times in one second and would reach the Sun in eight minutes. So far away is even the nearest star, however, that four years and four months are required for light waves from it to reach us—in the astronomer's words, it is "over four light years" away. Some stars are hundreds of "light years" away.

If we look through a pair of field-glasses or a small telescope the

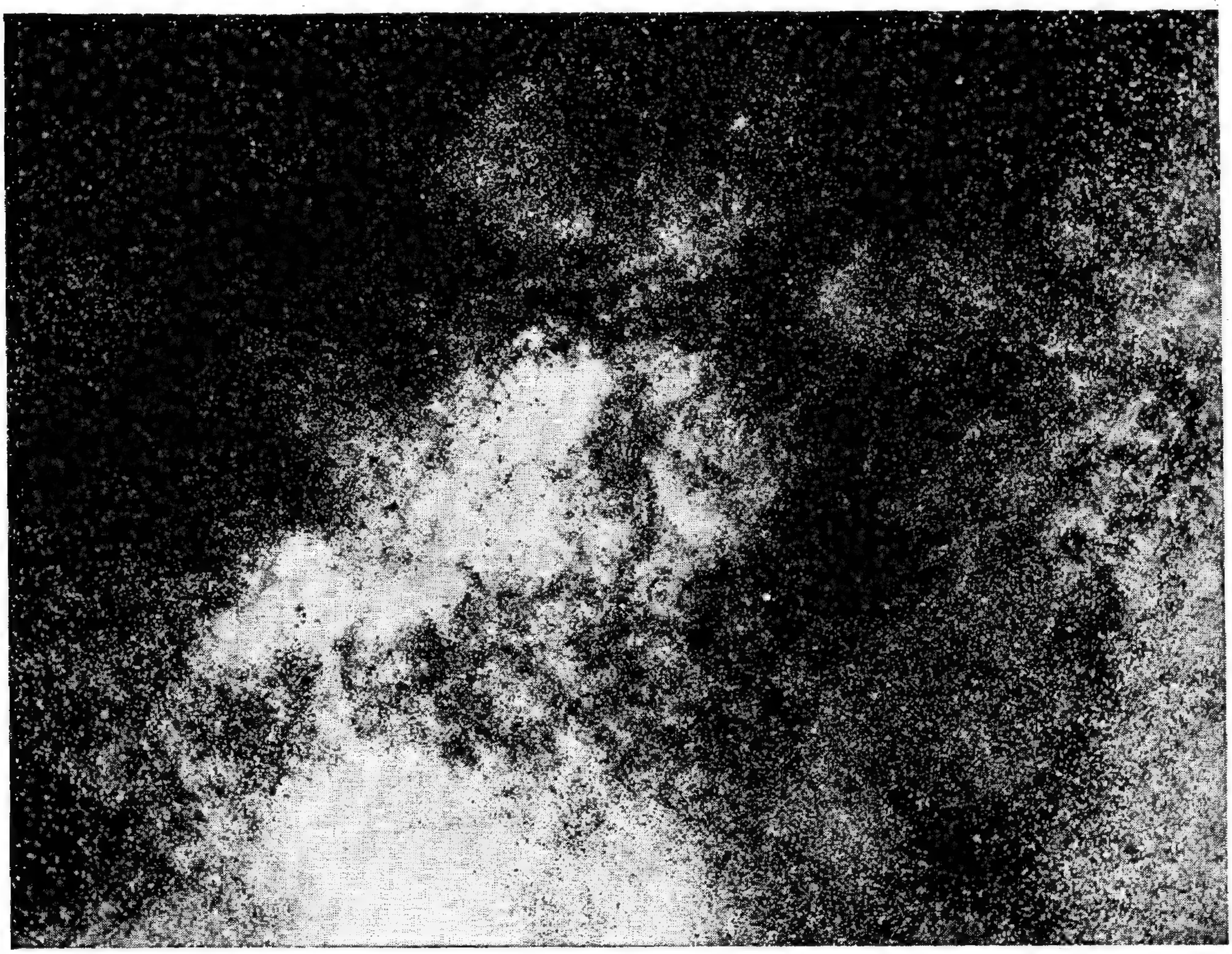


Photo by] [*Yerkes Observatory.*

PART OF THE MILKY WAY.

Every white dot is a sun, probably much larger and brighter than our sun.

number of stars to be seen with the naked eye is increased many times. In a large instrument the stars become quite uncountable, so that the astronomer has to resort to estimating their number. Very carefully-made estimates place the number at well over one hundred million, and when we remember that it takes a fortnight to count a million, working ceaselessly day and night, we gain some idea of this tremendous number.

In some parts of the heavens beautiful clusters are to be seen,

where large numbers of stars seem to have gathered together. In the great cluster in the constellation of Hercules there are over 6,000 stars—that is, about twice as many as can be seen in the whole of the sky with the naked eye on a clear evening. There are many other beautiful

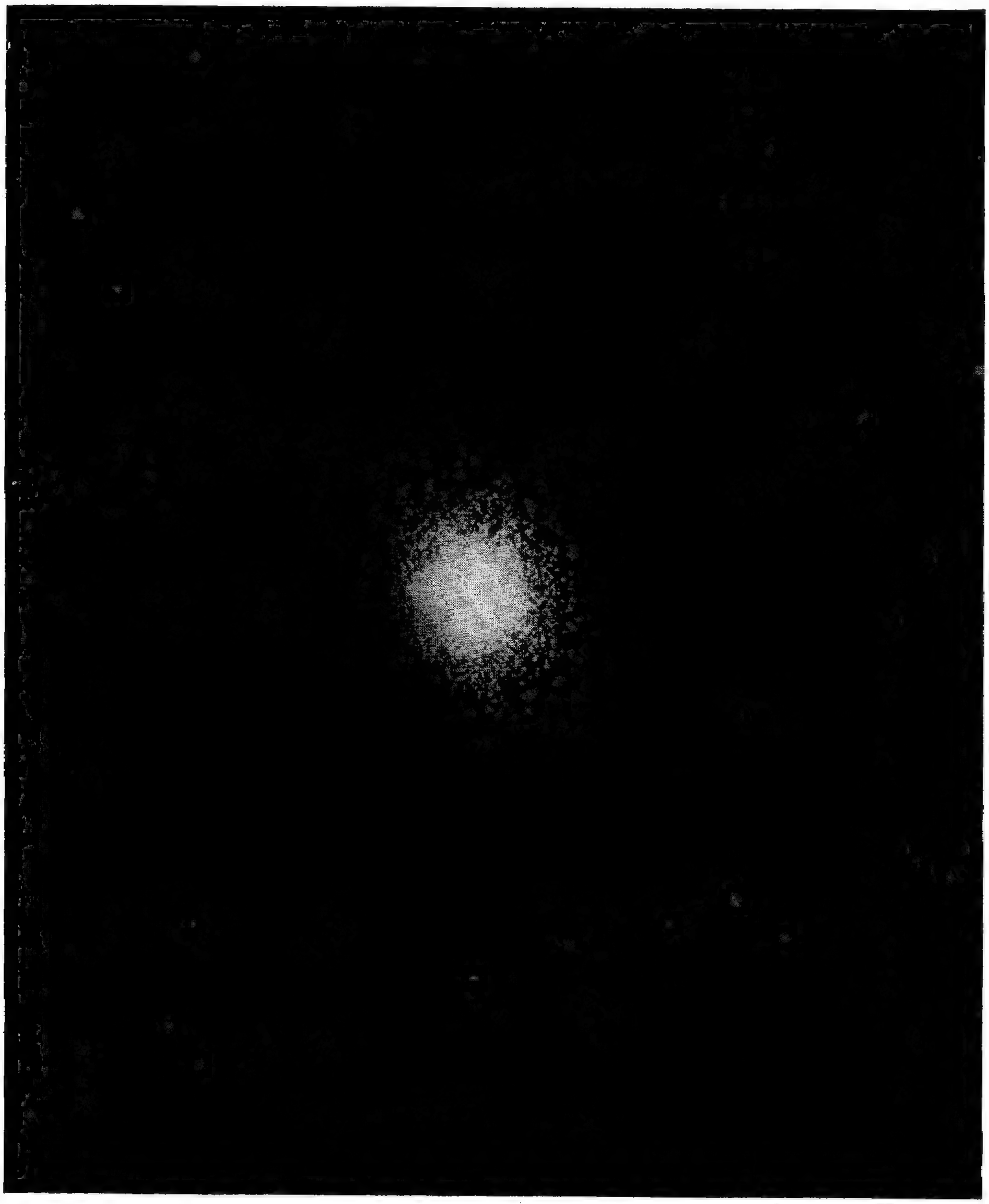


Photo by] *Yerkes Observatory.*

A WONDERFUL STAR CLUSTER IN THE CONSTELLATION OF THE "HUNTING DOGS."

In this cluster are more stars than can be seen with the naked eye on a clear night in the whole heavens. A great number of stars that appear to be single are really double, or even triple or quadruple, but so distant are they that they appear as one star.

clusters, including one near the Lion, called *Præsepe*, "the Bee Hive," because the stars are here so numerous that they remind one of bees swarming round a hive.

Other wonderful objects are the *nebulæ*, or clouds of gaseous mist.

Photo by] [*Yerkes Observatory.*

THE GREAT NEBULA IN ANDROMEDA.

Sometimes this famous spiral nebula may be seen with the naked eye. It has been known for centuries and is referred to in ancient writings.

numbers of small stars, so distinguish them separately. shows a small part of the Milky Way in all its beauty. In places the stars are so numerous that they seem to have been heaped on top of each other in shovelfuls ; elsewhere they are divided by dark spaces or rifts, as though passages had been cut through them with a knife. Hundreds of photographs have been taken of the Milky Way and each shows the stars to be as numerous as those in the photograph reproduced.

Of these, many thousands are scattered about the heavens and they are revealed in all their delicate beauty by the photographic plate. About 20,000 of these wonderful objects have been recorded. They are of all sizes and no two are exactly alike. Many are so small that the most powerful telescopes are required to render them visible ; others may be seen with a pair of field-glasses. One of the best known, the spiral nebula in the "Hunting Dogs," illustrated on page 97, seems to be whirling round in a spiral, and this form may be traced in a large number of others.

Most of the *nebulæ* are seen near the Milky Way, the name given to the band of misty light that stretches across the middle of the sky. A telescope shows that the faint light of the Milky Way comes from countless far away that the unaided eye cannot The wonderful photograph on page 98

Photo by] [*Yerkes Observatory.*

A SPIRAL NEBULA DISTINGUISHED BY A REMARKABLE DARK RIFT.

You will readily understand that it is impossible to count the stars of which the Milky Way is composed.

Although comets belong to a different class of bodies from either stars or *nebulæ*, they may rightly be classed among the wonders of the heavens.

Comets are of two kinds. Those belonging to the solar system revolve around the Sun in fixed orbits and so return periodically. Others visit us from the depths of space, to be seen only once. Perhaps the most interesting of all the comets is Halley's, so called after the great astronomer who predicted its return in 1758, before it was known that certain comets revolve round the Sun in regular orbits.

Another remarkable comet is the Morehouse comet, which appeared in 1908 and was chiefly notable for the extraordinary changes that took place in its appearance and in its tail.

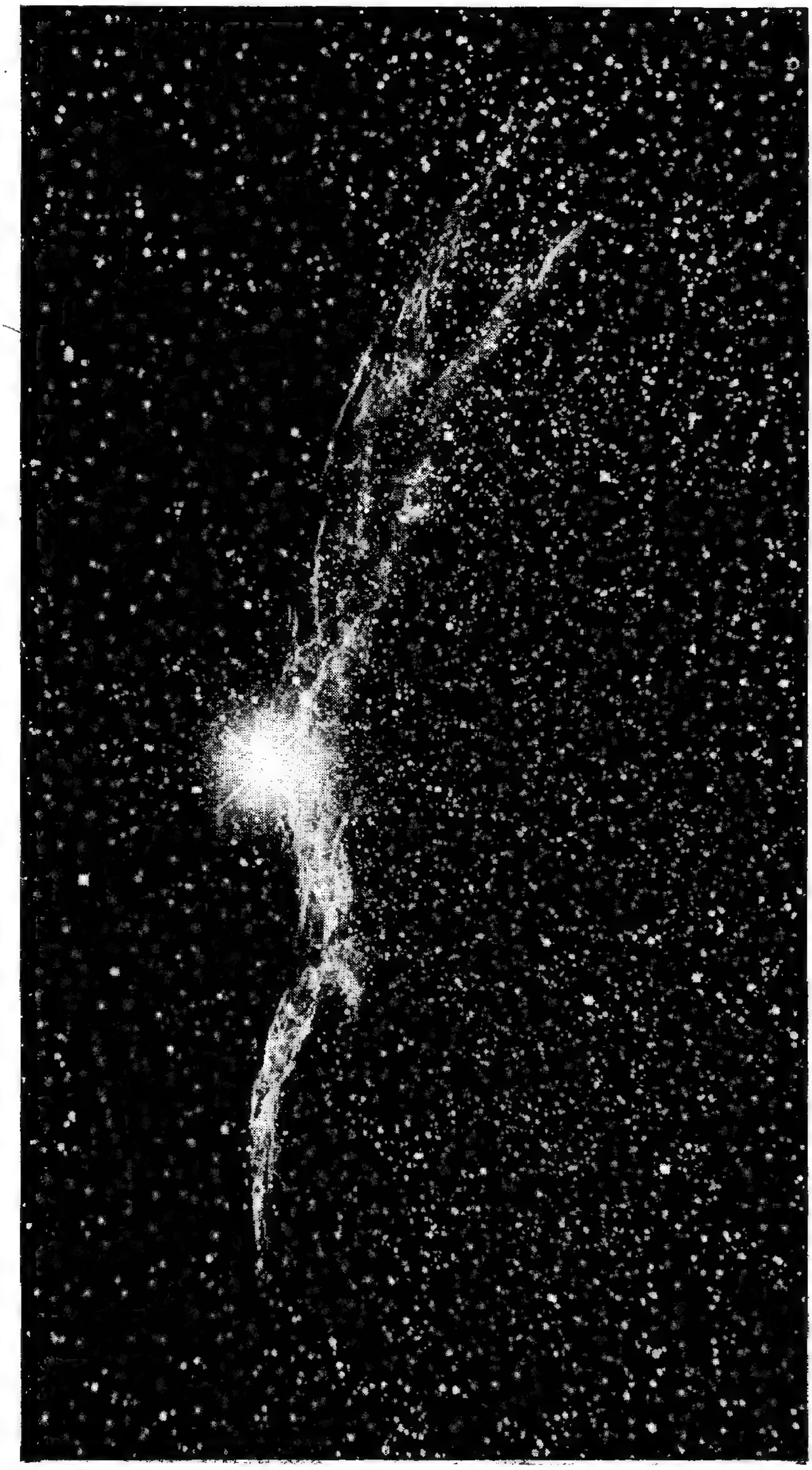
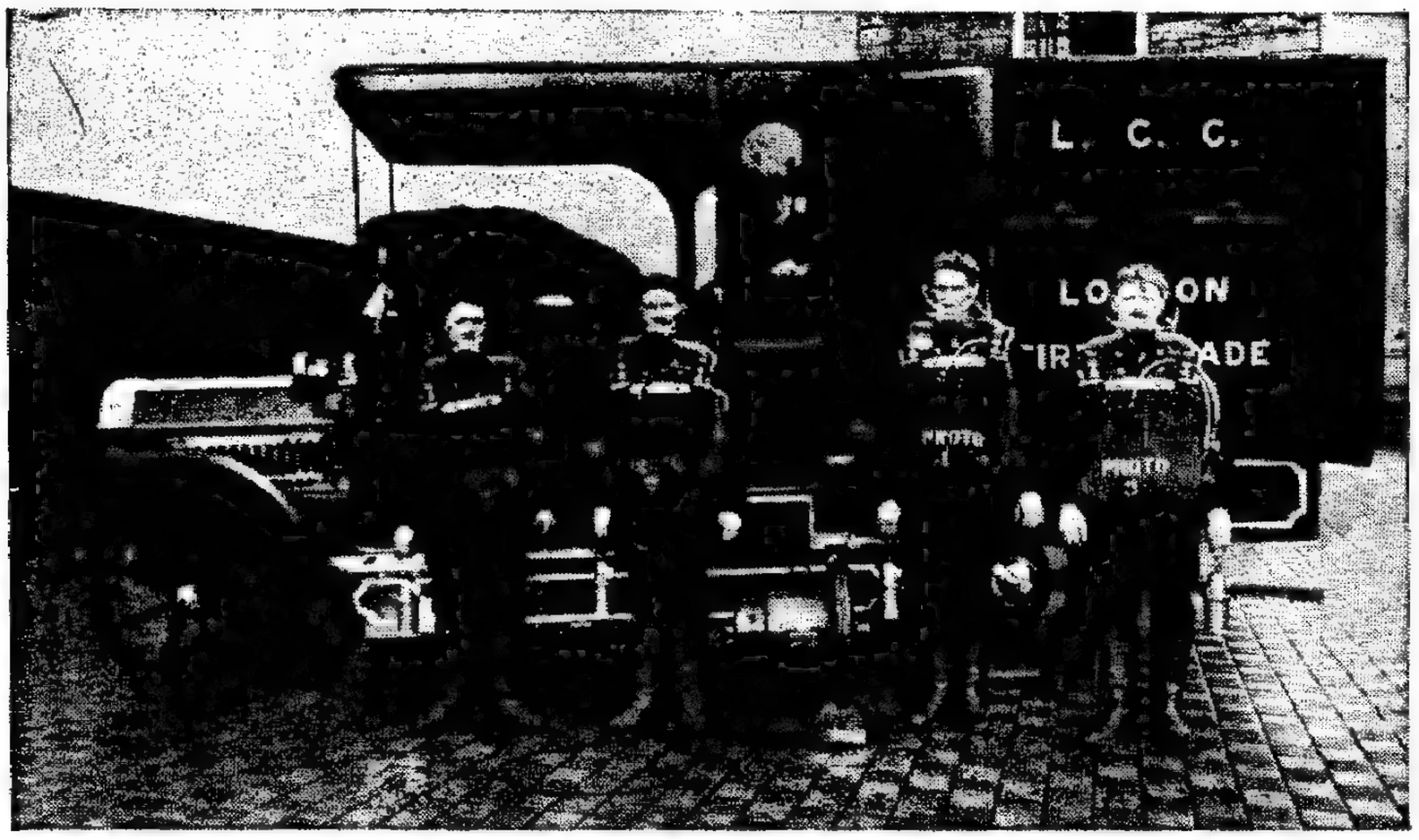


Photo by] [*Yerkes Observatory.*

THE BEAUTIFUL NEBULA IN CYGNUS KNOWN AS THE "BRIDAL VEIL."

Comets consist of two parts, the nucleus or head, and the tail, which always points away from the Sun. The tails of comets are probably composed of particles of matter given off by the heads and are of a very delicate nature. So thin are they that stars may often be seen through them, and this, perhaps, was the reason that the poet Oliver Wendell Holmes called them "the spectres of the heavens."

ELLISON HAWKS.



[*Clarke & Hyde.*

A LONDON COUNTY COUNCIL EMERGENCY MOTOR FIRE-CAR.

The men have breathing apparatus and smoke helmets, and the car is fitted with fans, searchlights, and many other appliances for dealing with fires.

Fighting Fire :

Some Wonderful Modern Appliances

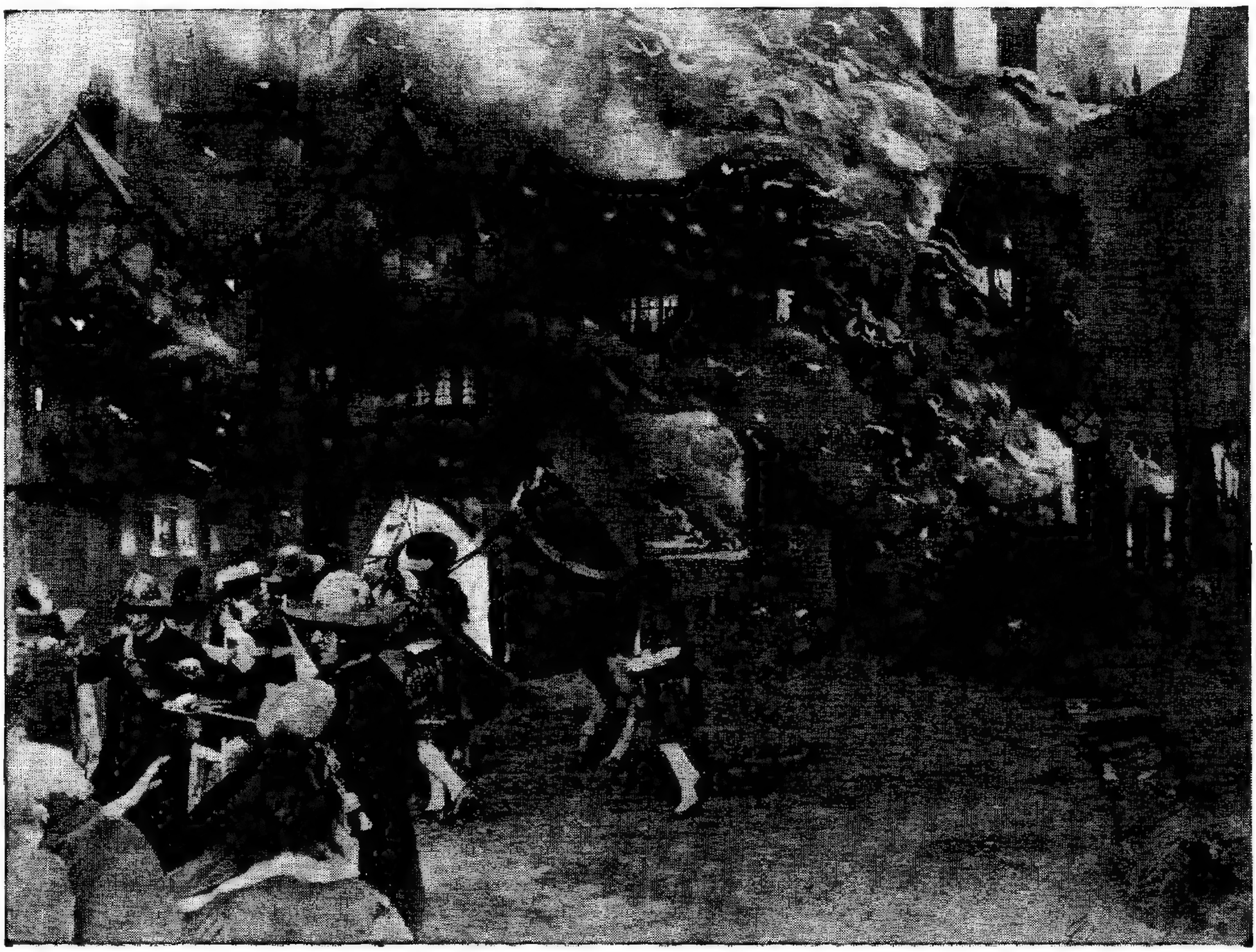
WHEN the clang of a fire-engine is heard in the street every head is turned, and few boys or girls can resist the temptation to run and see where the fire is and to watch the brave firemen at work. No wonder we are thrilled, for it takes but little imagination to think what would happen in any of our great modern cities if the Fire Demon were allowed to work his will unchecked.

The methods adopted and the appliances used for extinguishing a fire vary according to where it occurs, to its nature, and to the headway it has made. It is commonly supposed that water is the best thing to use, and, indeed, the only thing, but in some cases water is worse than useless. Most fires belong to one of three classes : (1) The small fire in a private house that can be put out without the help of the fire brigade ; (2) bigger fires in buildings where only fire-engines are of use ; and (3) fires in which quantities of petrol or oil of any kind are involved, whether the premises be a small motor garage, or a great storage reservoir that may contain millions of gallons of burning liquid.

When we think how easily and in how many ways a fire may be started in an ordinary house, it is surprising in how few houses precautions of any kind are taken. It may easily happen that the fire itself will prevent access to water taps, and the inmates of the house will be lucky if they escape without even attempting to check the fire. Yet there are ingenious chemical fire extinguishers, capable of dealing with a room completely on fire, that can easily be lifted

from a hook and used by a boy—if he knows how. They cost only three or four pounds and consist of a steel cylinder with a screw-down cap containing a solution of bicarbonate of soda, in which is another cylinder containing an acid solution. Near the top is a nozzle. If a fire occurs it is only necessary to turn the cylinder upside down, when the two solutions mix and generate bubbles of carbonic acid gas, known as firefoam, which can be directed on to the fire in a powerful jet that will reach a distance of nearly 50 feet. No fire can burn without oxygen, consequently the firefoam, by excluding air from the fire, promptly smothers it.

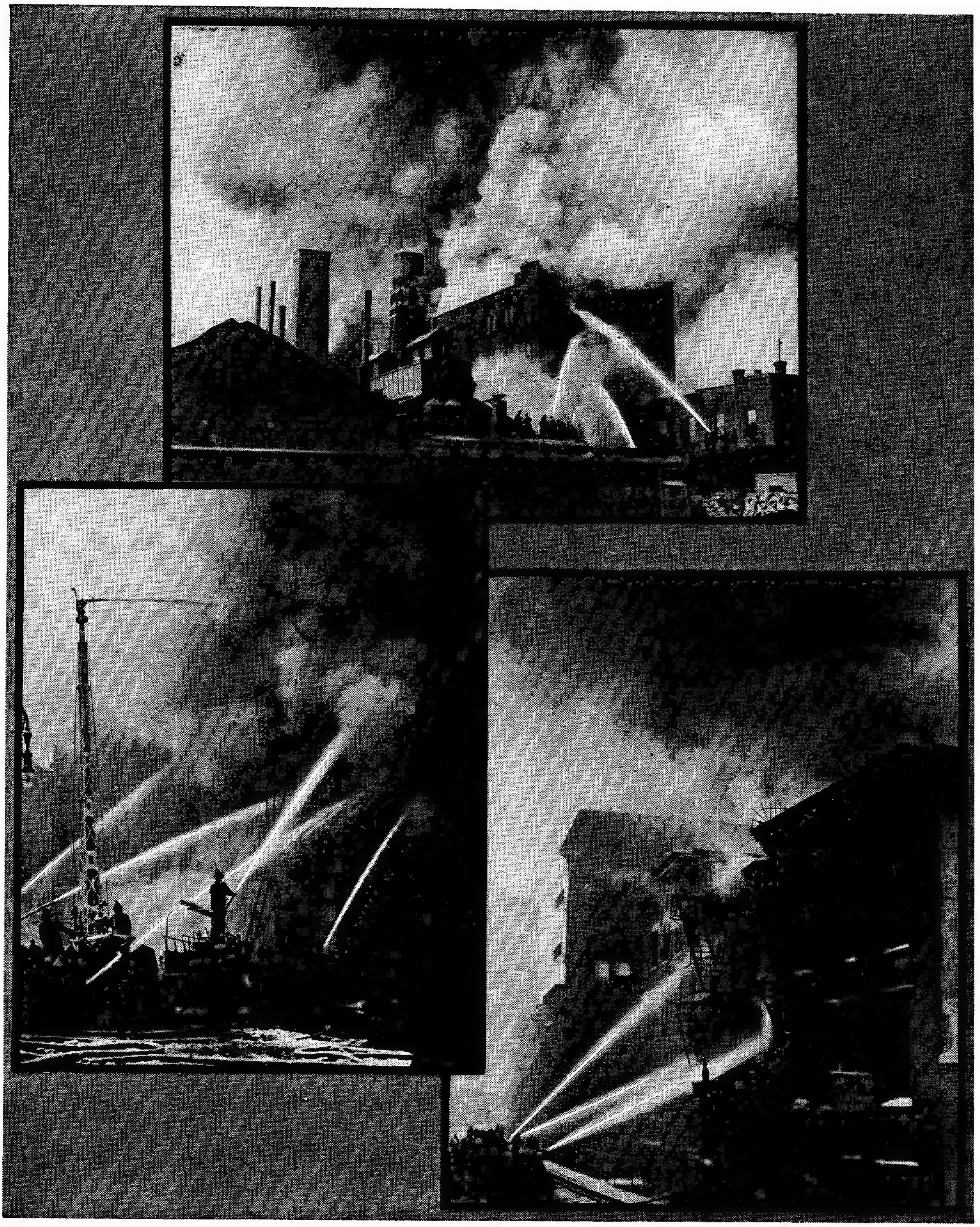
In the case of petrol or oil fires, since such liquids float on water and burn on it, the act of spraying water over them simply aggravates matters by extending the pools of burning liquid, and perhaps starting fresh fires. Similar appliances to that already described, but much larger, are used in such cases. The writer has seen a big tank of petrol with its entire surface alight extinguished by this method in a few



[By courtesy of Messrs. Dennis Bros., Ltd., Guildford.

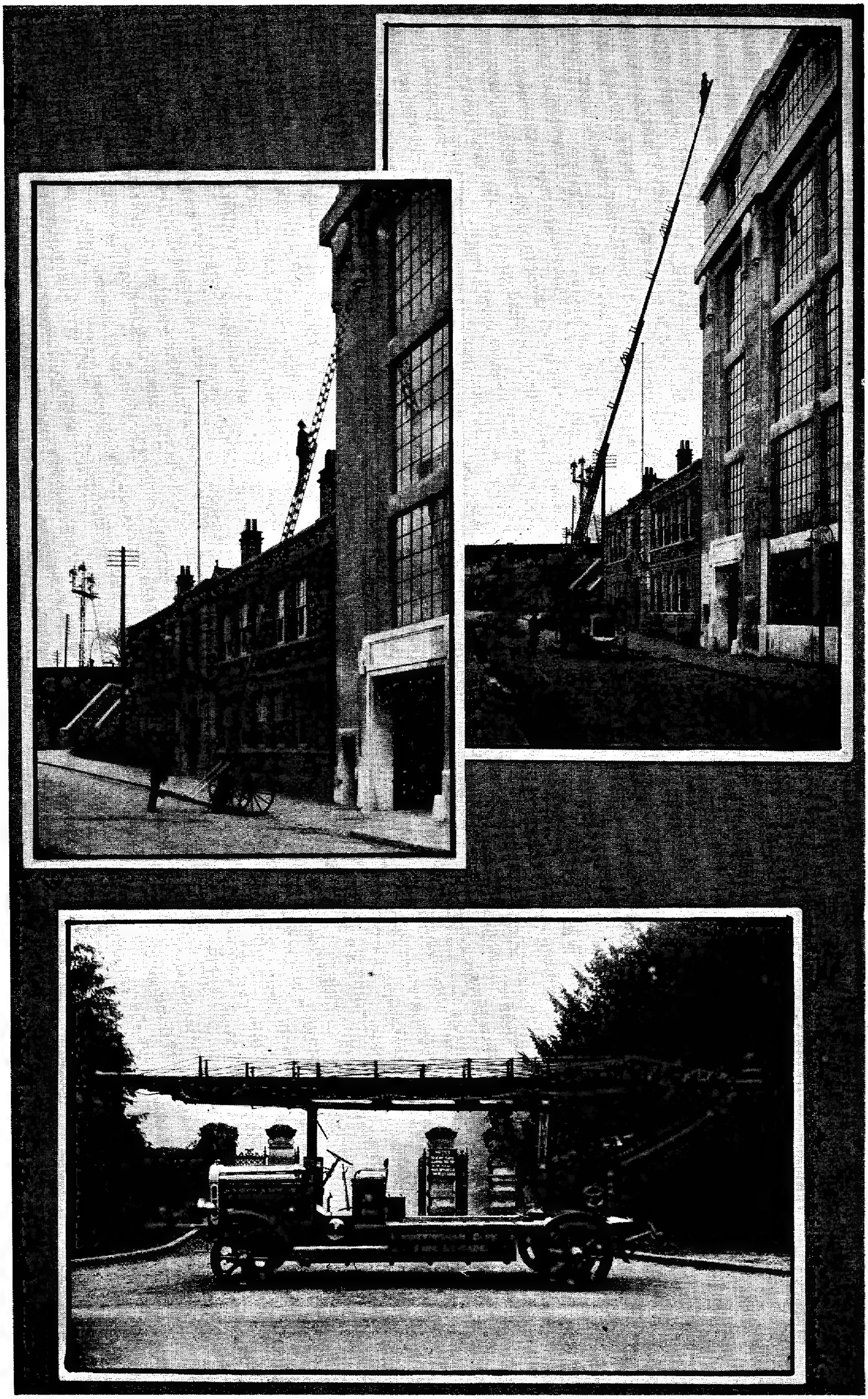
THE GREAT FIRE OF LONDON ON THE FILMS.

The men are shown using the fire-extinguishing appliances of the period, which it is interesting to compare with those of to-day. The picture is believed to be historically accurate in every respect.



Photographs by [*Albert Dreyfous.*

FIGHTING FIRES BY HOSE AND WATER TOWER.



Photographs reproduced by courtesy of Tilling-Stevens Motors, Ltd.

1. SLIDING CARRIAGE ESCAPE EXTENDED.

2. PETROL ELECTRIC TURN-TABLE LADDER EXTENDED TO 85 FEET. 3. THE LADDER FOLDED.

minutes. Many fire-engines nowadays carry cylinders containing chemical solutions and may not use water at all.

But for fighting fires on a really big scale the time-honoured practice of using water is still in vogue. The latest motor fire-engines of the London Fire Brigade are capable of sending a jet of water to a height of 340 feet, almost as high as the cross on St. Paul's Cathedral —far higher than " foamite " could be projected.

In 1921 the last of the horses belonging to the London Fire Brigade were disposed of, and every fire-engine, fire-escape and other vehicle is now driven by either electric or petrol motor. Within the area of 117 square miles protected by the London Brigade are no fewer than sixty-five stations and three river floating stations. The floating stations include powerful fire " floats," or vessels, with a speed of ten miles an hour, fully equipped with engines and pumps for subduing riverside and dock fires. There are about 175 motor fire-engines and escapes, travelling at speeds of from twenty to thirty miles an hour. Fire " ladders," as they are technically termed, such as those illustrated, can be raised in a few seconds to a height of 90 feet, together with a hose and firemen. They are supported on turn-tables on the chassis of the vehicles, so that they may be turned in any direction, and used quite independently of walls. An ordinary fire-escape, which is 50 or 55 feet high, is placed against the walls of a burning building, and two or more firemen mount it, each carrying a hook ladder about 14 feet long. The fireman at the top of the escape lifts his ladder and hooks it inside the window-sill of the floor above, takes another ladder from the man below and, running up the first, hooks the second to a still higher window-sill, and thus in a few moments reaches the highest floor or the roof of the building.

So perfect is the organization of the London Fire Brigade that, at any dangerous point in the great area under its protection, a hundred firemen can be at work within fifteen minutes of an outbreak. When an alarm is received at certain stations the men, instead of descending stairs, slide down brass poles from the floors above, one after another, jump on to their machines, and in a few moments are in the street and travelling at full speed. The first appliance to leave the station is the fire-escape, then the engine, and then a motor-van carrying sets of oxygen gas-masks which contain enough oxygen to enable the men to work in dense smoke for an hour at a stretch, searchlights and portable telephones, with hundreds of yards of wire, enabling

[*Special Press.*

A WONDERFUL DISPLAY BY A JAPANESE FIRE BRIGADE.

firemen out of sight to report progress to the officer in charge. All the firemen are trained to render first-aid to the injured, and surgical dressings are always carried in the vans.

Should the fire be a serious one, orders are telephoned from headquarters to other stations to send as many engines and as much equipment as may be necessary, and, as the engines leave, others from more distant stations are ordered up to take their place. In dangerous areas near riverside buildings the streets are so narrow that the men are seriously handicapped for want of room; in such cases the fire-floats get to work from the river, as in one of the pictures on page 104, projecting jets of water right over the shipping alongside the shore.

The number of fires in London averages between 3,000 and 4,000 a year, but of these not more than one in a hundred is serious. Security, however, is only gained at the price of vigilance, and we do well to remember that every hour and every moment, day and night, brave men are on the watch, ready to deal instantly with any outbreak that threatens our lives or property.

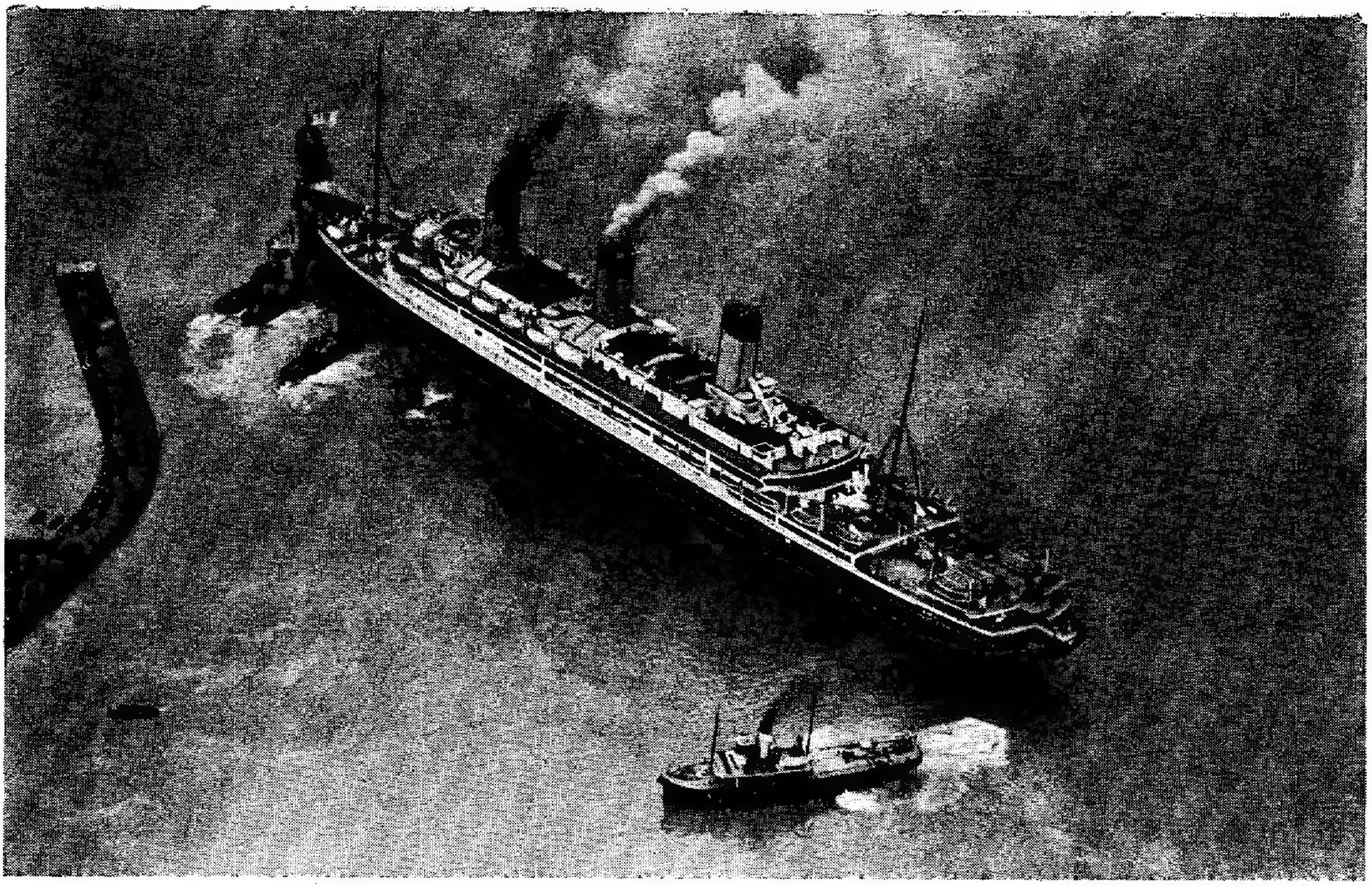
The risk from fire is often greater in isolated country places than in great cities. Often a stately mansion, with costly art treasures, has been burnt to the ground before help could arrive. But it is satisfactory to know that there are now turbine pumps weighing only ninety pounds which will deliver 200 gallons of water a minute, or even more, and which can be easily attached to any suitable type of motor-car.

P. J. RISDON.

[*Special Press.*

COULD YOU ROW LIKE THIS?

The natives of the South Shan States, Burma, and other Eastern people, propel their craft, often at amazing speeds, in this manner.



[*Central Aerophoto Co., Ltd.*

THE "MAJESTIC" AS SEEN FROM AN AEROPLANE.

A Wonder Ship

THE most famous ship in the world is the White Star liner *Majestic*, though it is now slightly exceeded in size, but not in carrying capacity, by the *Leviathan*, which sails under the flag of the United States. The *Majestic* was surrendered under the Peace Treaty to pay for some of the damage done by German submarines to our defenceless merchantmen. The White Star Company wanted a big ship to replace the *Britannic*, which had been sunk in the Mediterranean while acting as a hospital ship, and paid the Government a million pounds for the *Majestic*. To build such a ship at the present time would cost four or five times as much.

To talk about the dimensions of a ship is misleading, because it is difficult to judge the measurements, and they seldom give the idea of bulk that one gets when standing alongside the ship herself. However, the *Majestic* is no less than 956 feet long from stem to taff-rail, and when you remember that this is well over a sixth of a mile, you will realize the tremendous strength that has to be possessed by

the keel plating in order to prevent the ship from folding up like a carpenter's rule when she meets the huge Atlantic rollers. She is just 100 feet in beam, and the hull of the ship itself, from the keel to the level of the boat-deck, is 102 feet deep. These measurements give a gross registered tonnage of rather more than 56,000, but the actual weight of the ship and her contents, as measured by the water she displaces, is 64,000 tons. A huge figure when it is remembered that the great new battle-cruiser *Hood*, the biggest British man-of-war in commission, is under two-thirds of that size.

When the *Majestic* was laid down everybody expected a "flyer," but the Germans apparently, after mature consideration, decided that the honour of being the fastest ocean greyhound was not worth the price in fuel, and she was built for the moderate speed of 23 knots. So the shipping world was given to understand, and it laid its plans accordingly. When the White Star Line came to "try out" their purchase, however, they discovered that she had never been designed as a twenty-three knot ship, but as a twenty-five knotter specially intended to wrest the Blue Riband of the Atlantic from the Cunard *Mauretania*. This was a clever advertising device, for it was realised that the *Mauretania's* record of crossing the Atlantic in 4 days, 10 hours and 41 minutes would want a deal of breaking. If the *Majestic* failed, of course nobody could expect a twenty-three knot vessel to beat one designed for two knots more; if she succeeded, the feat would be the finest advertisement imaginable both for the Hamburg-America line and for Germany. The British company, however, saw no reason to dissemble, and the result was a most exciting series of races between the *Majestic* and the *Mauretania* which did much to reawaken public interest in merchant ships. Both of the giants are twenty-five knot ships and are able to speed up to twenty-seven for hours on end.

The heating surfaces of the boilers cover no less than five acres, but the beam of the ship is so great that this does not mean the occupation of such a great length as would be imagined. As a matter of fact, all the fumes lead up to two funnels, but it was felt that a pair of smoke-stacks pushed right up forward would make the ship unsightly, so a dummy after-funnel was fitted over the engine-room, the ventilating arrangements of which are placed inside it. The uptakes to the two real funnels are at the sides of the ship, joining on the centre line above the hull proper and behind the four promenade

decks that give her such a towering appearance. This arrangement means greatly added convenience to the passengers. Like most modern liners, the *Majestic* is a turbine ship, her engines being designed to develop a hundred thousand shaft horse-power when they are "pushed," though they will seldom require as much as that on ordinary service.

Should a disaster occur, there are numerous lifeboats and also two big motor lifeboats which are capable of passing a towline to a number of the ordinary pulling boats and then sending out wireless signals giving ships coming to the rescue their exact position. This will prevent the boats from separating and having to be searched for over a large area, as has so often happened. Fire is also guarded against by the most effective means known; as soon as the temperature of a compartment rises above a certain point water is turned on automatically and drenches the outbreak whilst the ship's fire-fighting party is being got together. If anything begins to smoulder without giving out great heat—the most fruitful cause of serious ship fires—the smoke is drawn through long lengths of piping by air suction and discharged under the nose of the officer on watch in the chart-house, who cannot fail to notice it. Also there are three wireless installations—one for very long distances, one for ordinary daily work, and one for emergencies placed as high up as possible, so that it cannot be put out of action by water until the ship is actually on the point of sinking.

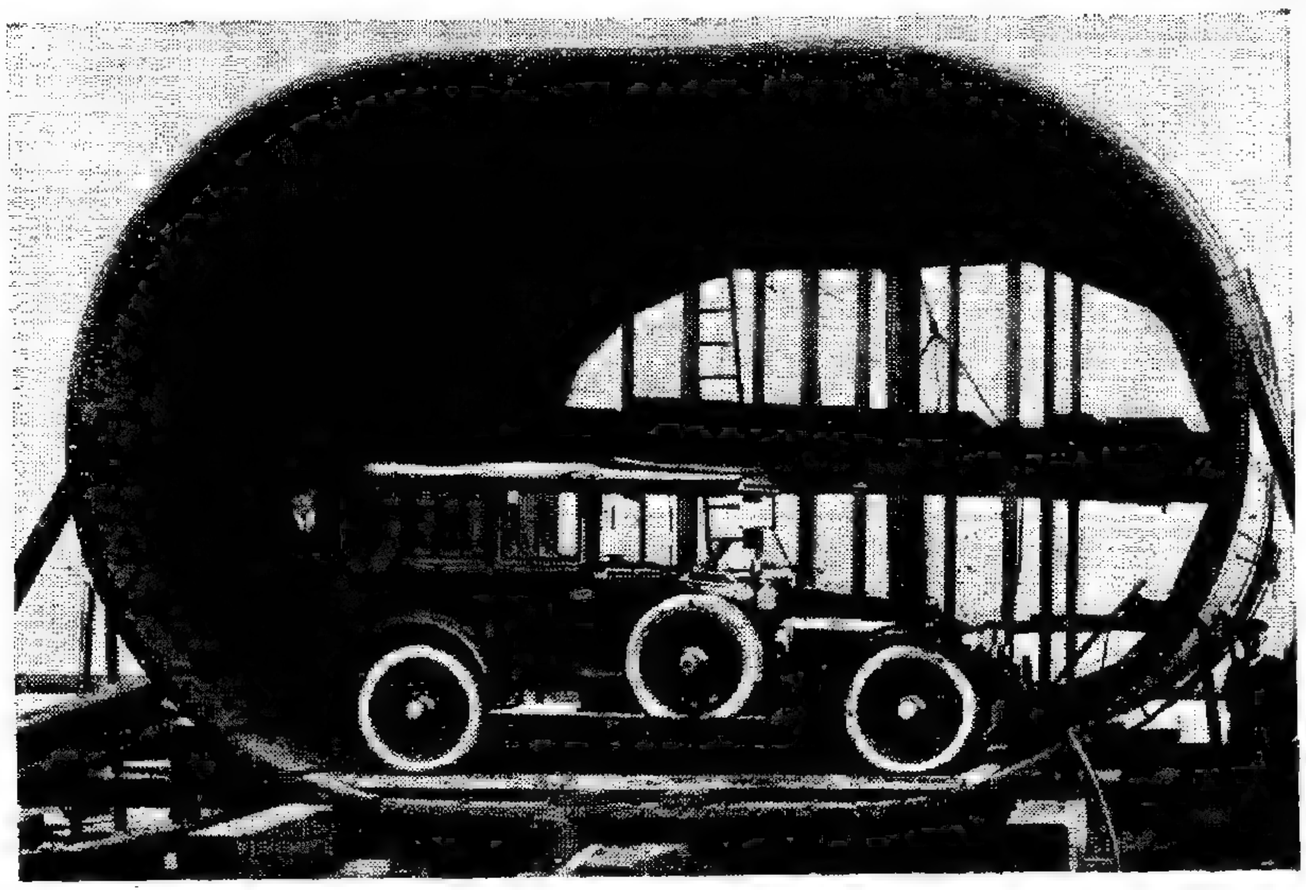
Such, in brief, is the wonderful vessel which the engineers set themselves to bring into being, but there are others whose tasks were no less colossal. All the passengers have to be accommodated with the greatest possible comfort and convenience, and as there are about four thousand of them this is no light business. Any number of ideas were necessary to make every cabin "just right," and the public rooms were a problem no more easy of solution. The passengers of an ocean liner are sometimes curious people to handle, and any unnecessary bickering and quarrelling is to the disadvantage of everybody concerned. Therefore saloons and lounges have to be designed which will let anybody get away from people who annoy him, and yet not be so small that they will encourage little social cliques. A lounge with an area of 4,000 square feet and a palm court and restaurant of 5,000 feet are included in the public rooms. The dining saloon of 11,350 square feet, with a height of 31 feet, is the loftiest

apartment ever built in a ship. A swimming bath with an area of 820 square feet holds about 120 tons of warm sea water, while electric baths adjoin the main room, and thirty dressing-rooms are arranged round the sides.

The task of organizing the food supply requires the experience and knowledge of the manager of a large first-class hotel. By some mysterious means the food emerges from the huge cold stores in the same condition as the fare of the very best restaurants ashore. Some idea of the work and organization involved can be formed from the following particulars of the *Majestic's* domestic outfit when she left Southampton on her maiden voyage in May, 1922: 190,000 pieces of linen, comprising 77,000 towels, 13,000 pillow-cases, 8,000 bed-covers, 11,000 sheets, 10,500 blankets, 6,000 quilts, 5,500 aprons, 45,000 napkins, and 10,000 tablecloths. The blankets alone weighed 17 tons. The vessel also carried 29,000 pieces of glassware, including 8,000 tumblers, 1,600 water-bottles, 7,000 wine and spirit glasses, 3,000 salt, pepper, and mustard pots, together with 80,000 pieces of earthenware. Of electro-plate and cutlery, no less than 50,000 pieces were required to furnish the steamer, and an extra quantity of at least 5,500 pieces to equip the restaurant, as distinct from the ship. Ten thousand knives and forks were also necessary, and other items to be provided were 3,000 beds, with the necessary pillows and bolsters.

Although it is still impossible to build a ship that will not make her bow to the big Atlantic rollers, yet in a huge vessel of this kind motion is reduced to a minimum, and the worst sailor can rest assured that the naval architect has done his utmost for him.

FRANK C. BOWEN.



[*Fleet Agency.*

WITHIN THE FUNNEL OF A BIG OCEAN LINER.

There is plenty of room for a full-sized car; in fact, several others could be packed in.

THE "MAJESTIC," THE LARGEST BRITISH LINER (56,551 TONS).

[*Topical.*

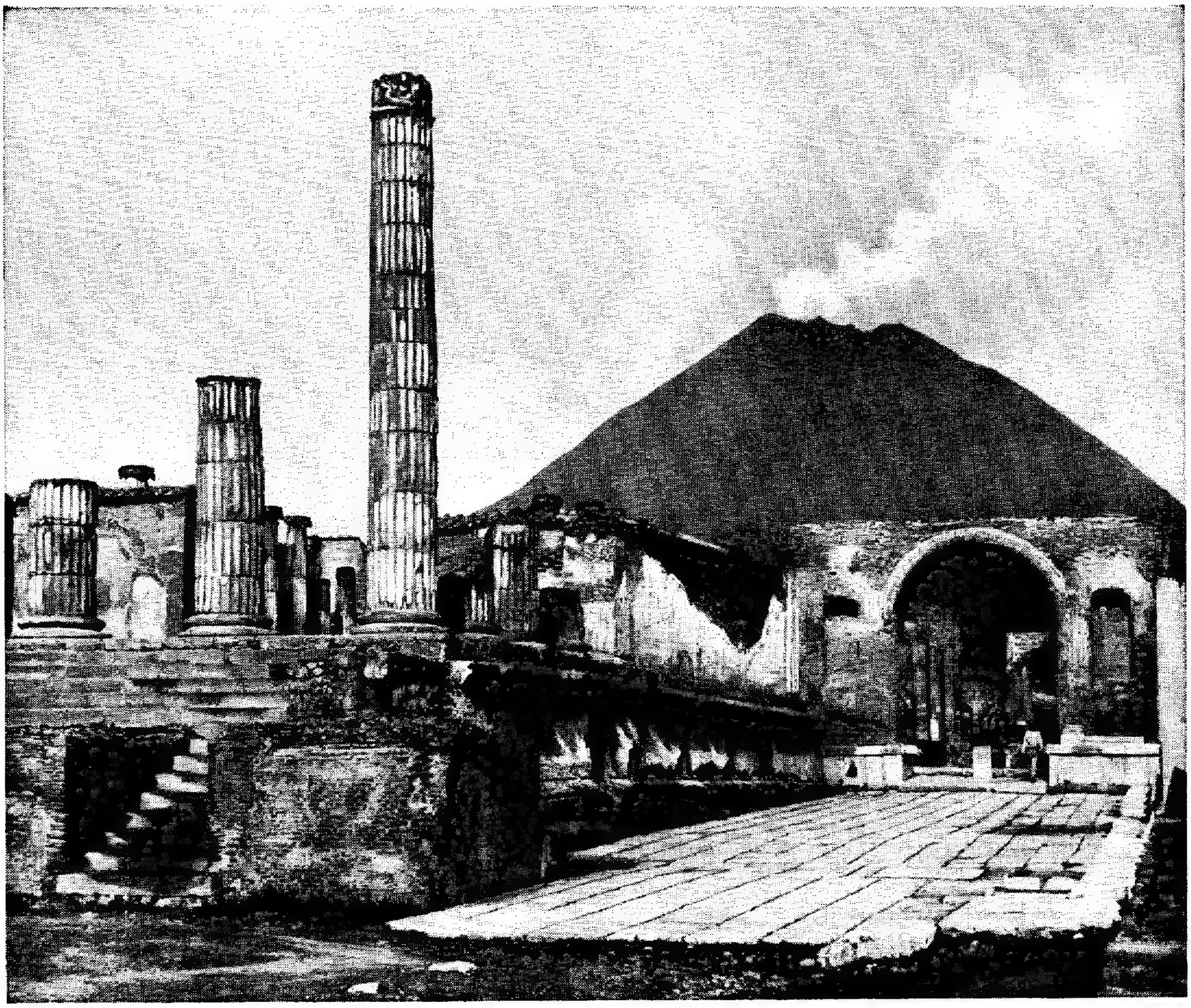
RUINS OF THE PARTHENON, ATHENS.

Considered the finest example extant of Greek architecture of the Doric order. Some of the beautiful statuary which formed the frieze may be seen in the British Museum, as the "Elgin Marbles."

The Glories of Greece and Rome

YOU do not need to read very much of ancient countries and civilizations before you realize that they had a way of borrowing from one another, just as modern countries do, and the borrowing was mostly in regard to big and beautiful things. We find many traces of this in old buildings, statuary and paintings, although, often in the transfer from one country to another great changes took place. The Greeks, for instance, are supposed to have borrowed the idea of the column in architecture from the Egyptians, but the Greek and Egyptian columns differed considerably. Rome, again, borrowed most of her art from Greece, but Roman art and Greek art are quite distinct. Sometimes, indeed, you see rather mixed art, as in the buildings which the Romans erected in Egypt. But when two styles are placed side by side, as in the case of the houses at Pompeii, some of which were Greek and others Roman, it is very easy to distinguish them.

To the Greeks beauty of form and nobility of thought were always first considerations, and of their art and architecture there is no finer example, perhaps, than the famous Parthenon on the Acropolis at Athens. This, the most beautiful of Greek temples, has suffered sadly from foreign hands, having at one time been used as a Turkish powder



[*Donald McLeish.*

THE WONDERFUL BURIED CITY OF POMPEII.

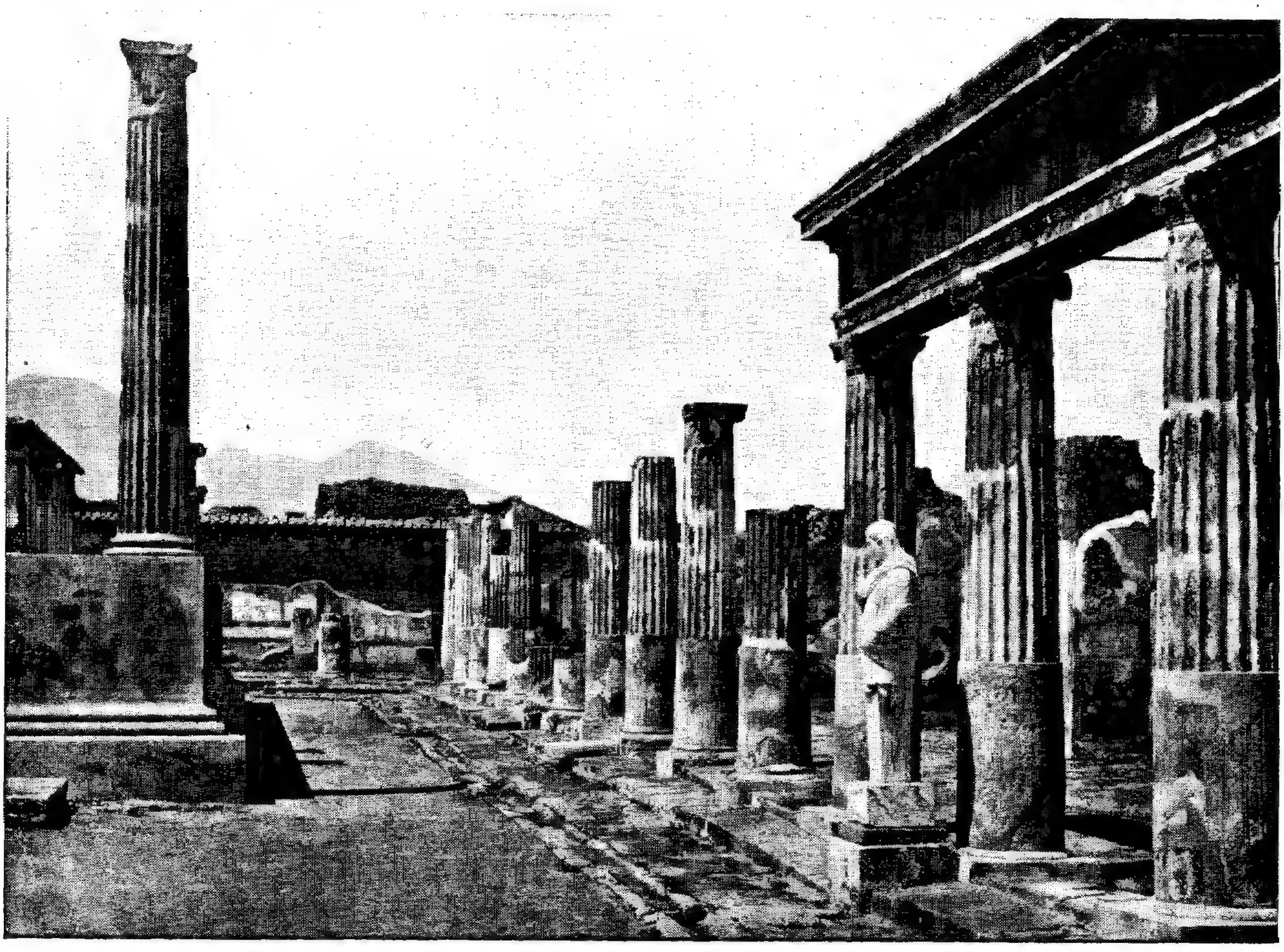
In the foreground are the ruins of the Temple of Jupiter and the Forum. In the distance towers Vesuvius, an eruption from which, in A.D. 79, overwhelmed the city. Excavations are still taking place, revealing more and more of the wonders of "the Roman Brighton."

magazine, the explosion of which destroyed nearly half the building. A quantity of the sculpture, too, including a large portion of the famous frieze, was carried off by Lord Elgin to this country, and now forms the world-renowned exhibit known as the Elgin Marbles in the British Museum. The Parthenon is not a very large temple, but it is beautifully proportioned, and the sculpture, in which a number of Greek deities and legends are magnificently illustrated, is superb. Specially notable are the chariot groups and other figures carved on the frieze, and illustrating the procession in the festival of Athene, the protector of Athens, which at the time of the building of the Parthenon had attained, under Pericles, the zenith of its career.

But Greek art was by no means confined to Greece, and some splendid examples of it are to be found in the Greek colonies in Asia

Minor and Italy, and in the islands of the Eastern Mediterranean. At Ephesus there was the great temple of Diana, and at Rhodes the Colossus, a giant figure, 120 feet high, with a thumb the size of a man, straddled the harbour for fifty years, and was then destroyed by an earthquake. There were also numerous Greek colonies on the coasts of southern Italy and Sicily, some of which had risen to great power and wealth while Rome was yet in its infancy. Boys and girls who have read Macaulay's *Lays of Ancient Rome* will remember the reference made by the Great Twin Brethren, in the "Battle of Lake Regillus," to their temple in "gay Tarentum," which was "hung each morn with flowers," and Sybaris, which was destroyed in 443 B.C., was so noted for its "idle rich" that the term "Sybarite" has for twenty odd centuries been used to denote those who lead lives of luxurious indolence.

Rome conquered Greece, but Greek art captivated the Romans, and after their practical fashion they imitated it, though they never succeeded in transferring to their own architecture, sculpture, and paint-



[*E.N.A.*

THE TEMPLE OF VENUS, POMPEII.

D. Anderson,] [*Rome.*

THE COLOSSEUM, ROME.

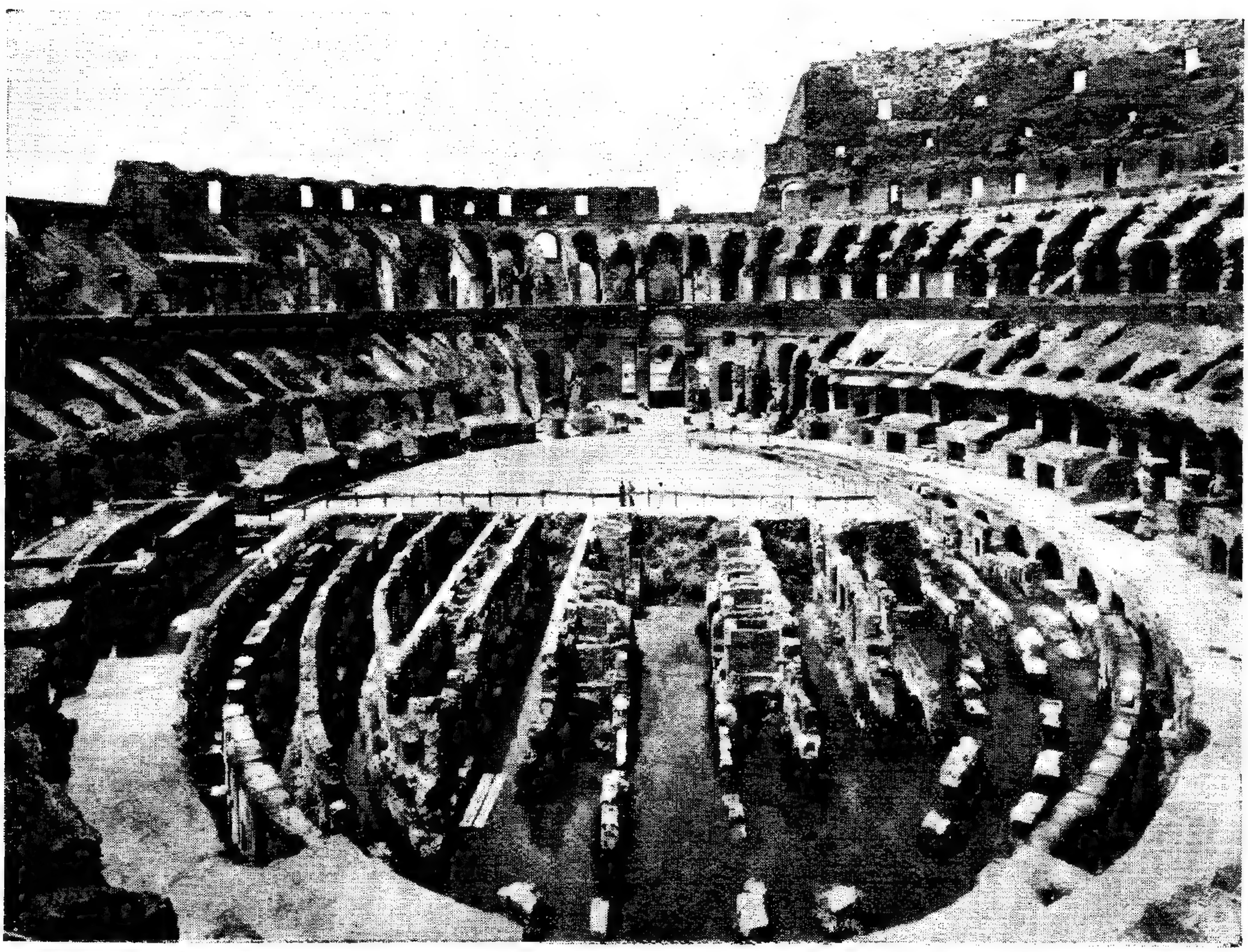
This huge building was capable of seating 45,000 people, and had standing room for another 8,500. It was the scene of countless gladiatorial fights and martyrdoms.

ing the exquisite beauty of early Greek design and craftsmanship. This is shown in an interesting manner, as already noted, by the Greek and Roman houses at Pompeii, which was a sort of Roman Brighton until an eruption of the neighbouring volcano of Vesuvius overwhelmed it in A.D. 79. Here among the excavated ruins we have Greek as well as Roman houses, and in the former everything is both beautiful and simple. "Even the kitchen," says a writer on Art, "is pleasant to look at; the utensils, from the bronze bowl to the commonest pot, are as convenient as they are graceful in form and decoration, and are often of exceeding beauty. . . . The lamps and candelabra are also for the most part beautiful works of art." The ornamentation in the Roman houses is very elaborate, especially in the matter of mosaics and paintings, but it is often extravagant and unnatural, and lacks the perfect taste shown by the Greeks in all they built, and carved and drew. Over the doorway of a Pompeian Greek house, again, we find the kindly greeting *Salve* (welcome), but in the vestibule of a Roman one is *Cave canem* (beware of the dog)!

Typical of the solid grandeur of Rome is the Colosseum, the huge amphitheatre begun by the Emperor Vespasian and completed by Titus, which had 300 entrances and in which over 50,000 spectators could

witness the often dreadful scenes enacted in the vast arena. Here hundreds of devoted Christians were flung to lions and tigers in full sight of the inhuman populace, and terrible combats between gladiators took place under the approving eyes of Emperors who sought the favour of the people by making the spectacles in the Colosseum as sensational as possible.

Like the Greeks, the Romans planted many colonies and raised many important structures in them, of which an interesting example is given in our picture of the ruins of the grand Aqueduct at Segovia, an old city of Spain some thirty miles to the north of Madrid. This aqueduct was built in the time of Trajan, and consists of two rows of arches, the one resting on the other; it is 102 feet high and over 800 yards long. It was in engineering work of this substantial and thoroughly practical sort that the Romans chiefly excelled, and the solidity of their masonry is proved by the manner in which their buildings have lasted. The astonishing aqueduct which carried water to Rome itself from the Sabine hills, forty miles distant, still stands



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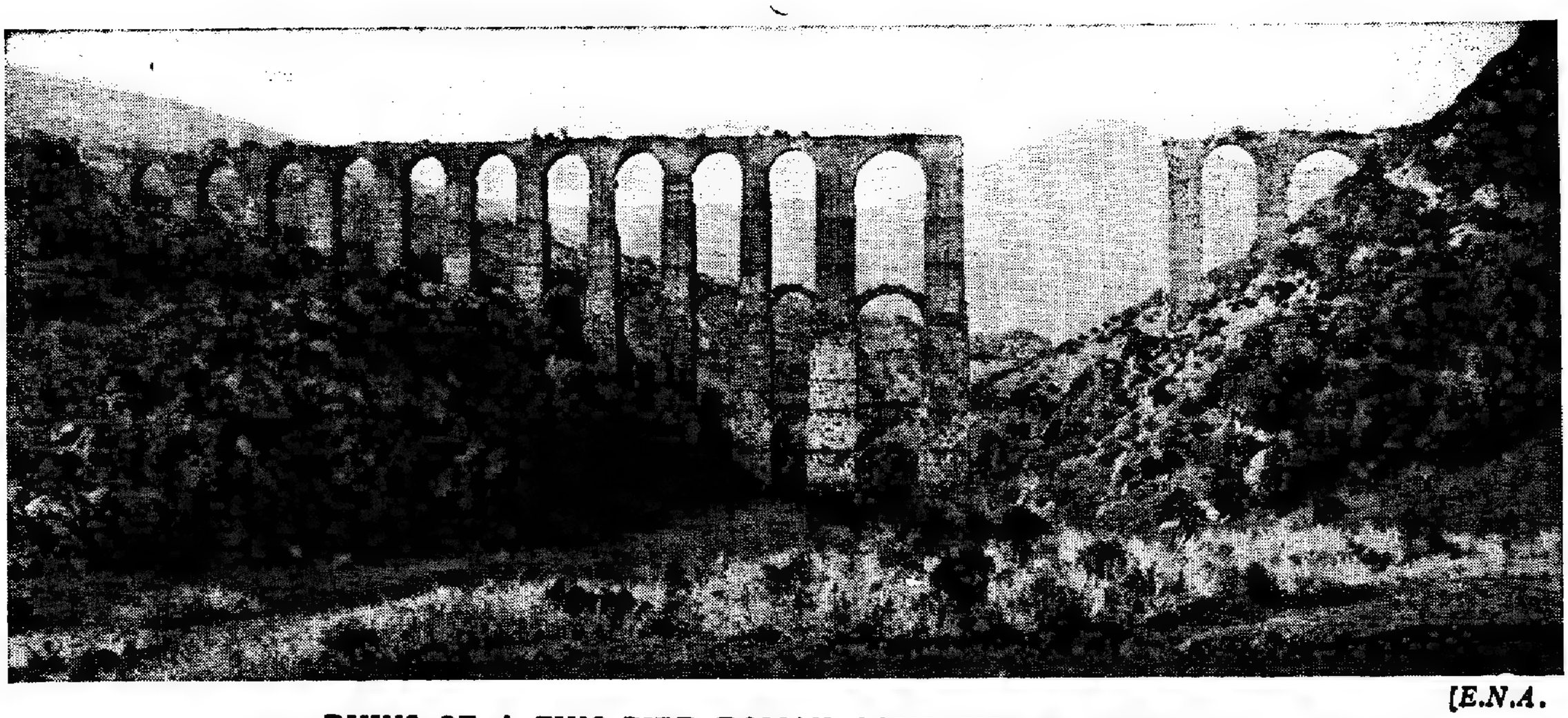
INTERIOR OF THE COLOSSEUM.



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RUINS OF A TWO-TIER ROMAN AQUEDUCT IN ALGERIA.

firm, and the pavement of the Appian Way shows few signs of being over two thousand years old.

There are plenty of relics of the Roman occupation of Great Britain, which lasted nearly 400 years, and a glimpse of which we get in Kipling's delightful book, *Puck of Pook's Hill*. A Roman bath is still one of the sights of London; there is another at Bath, and the remains of Roman villas in a fine state of preservation can be seen in Sussex, the Isle of Wight, Cirencester, and elsewhere. Of forts and camps there are many ruins, and when the foundations of Cannon Street Station were being dug out part of the wall of a very early Roman

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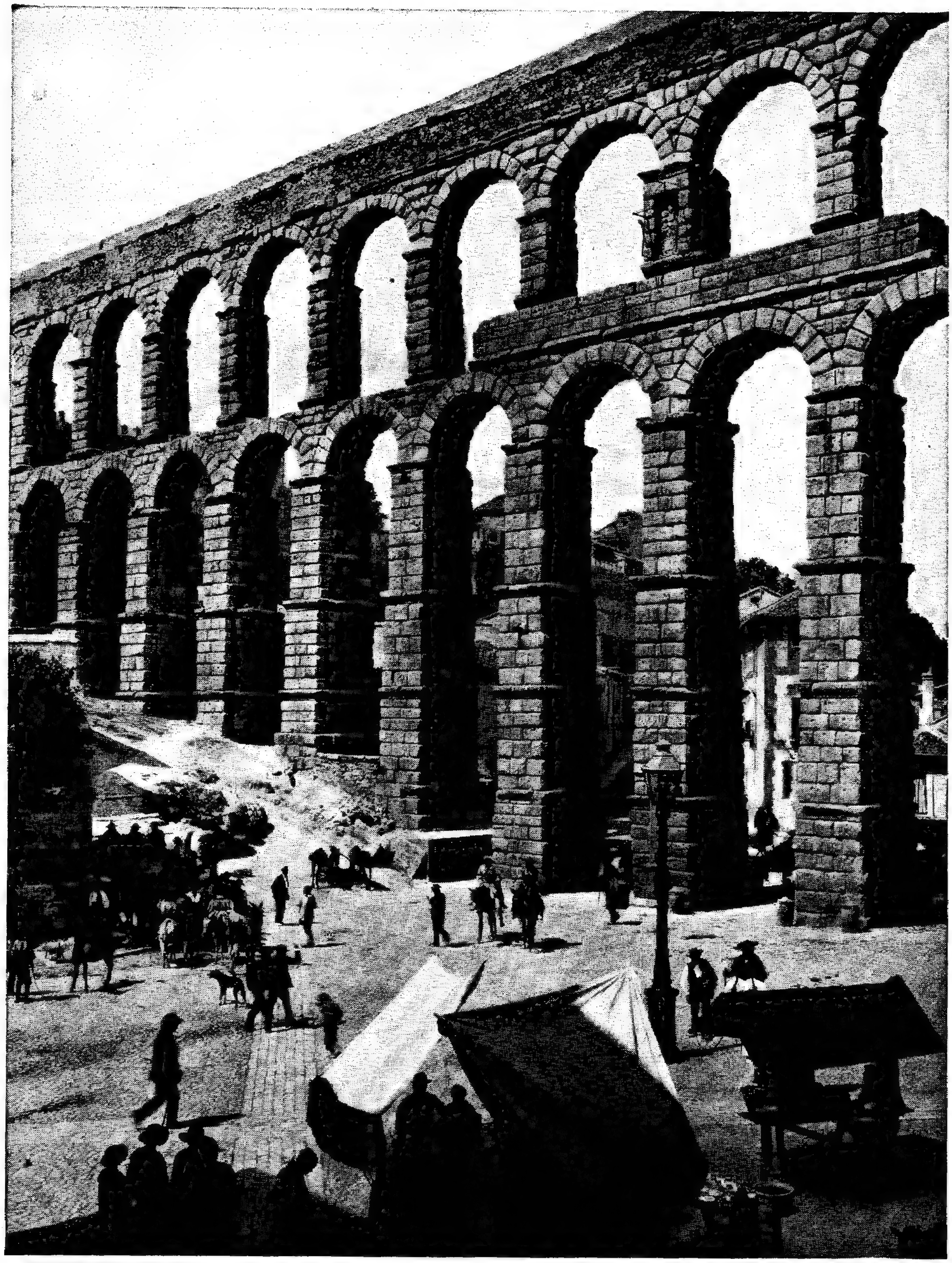
STILL SHOWING THE MARKS OF ROMAN CHARIOT WHEELS.
The ruins of ancient Timgad, Algeria.



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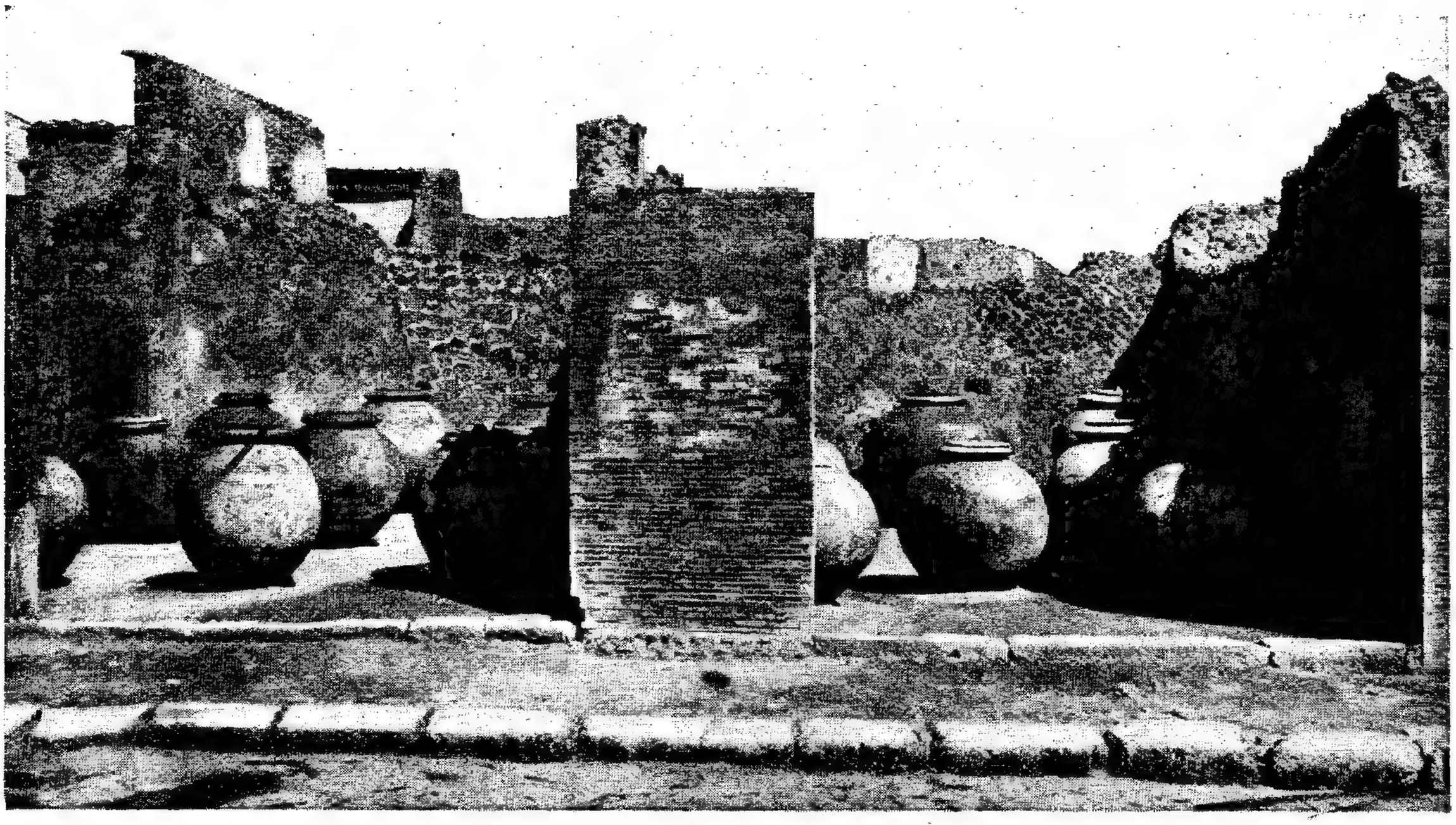
ROMAN AQUEDUCT, SEGOVIA, SPAIN.

Sometimes these great works, of which there are many remains in Italy, Spain, and elsewhere, ran for over fifty miles. Occasionally there were three rows of arches. Rome is still partly supplied with water brought by ancient aqueducts.



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THE SHOP OF AN OIL MERCHANT, POMPEII.

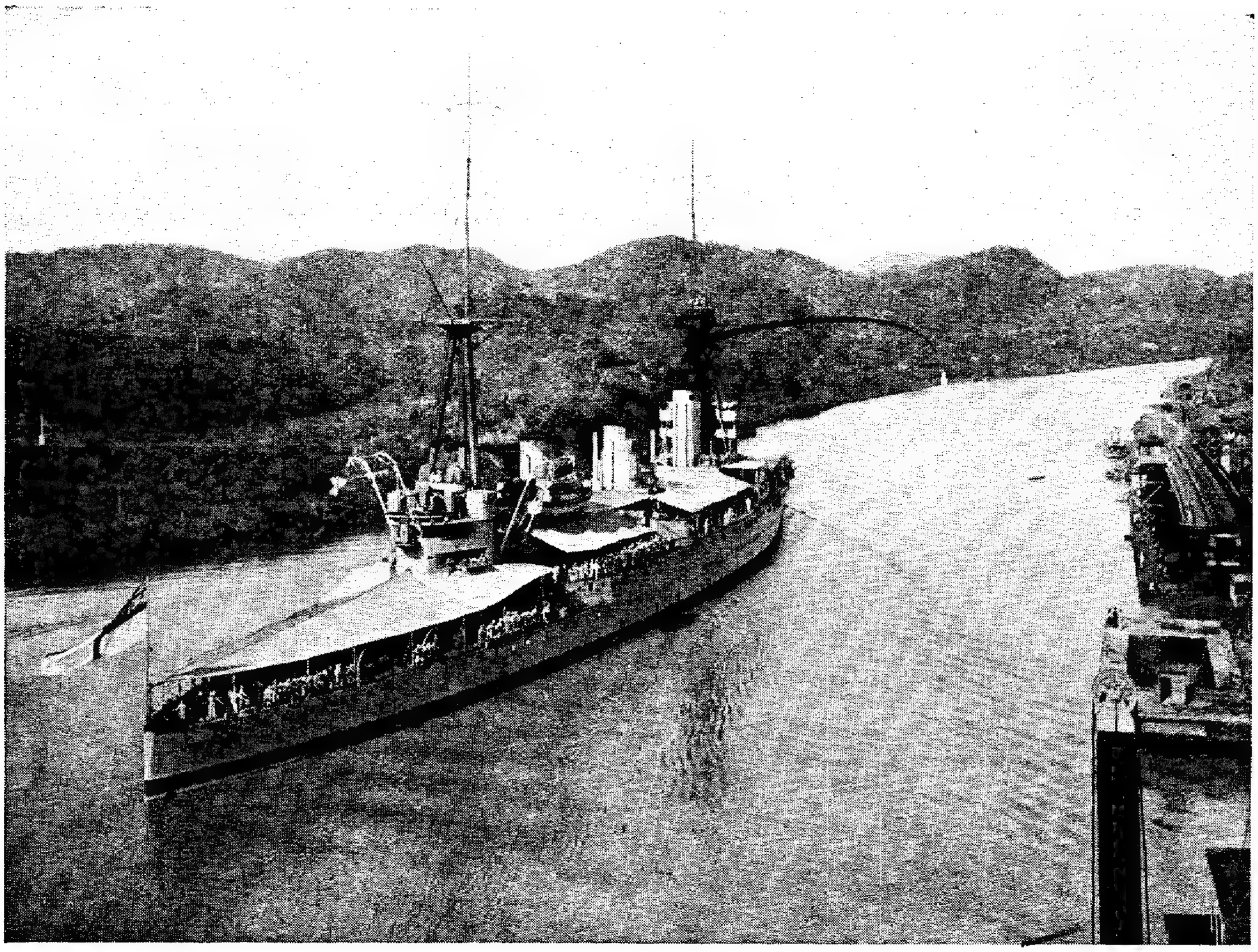
fort was found, with the mortar set as hard as stone. The Romans also built the first bridge in London, very nearly, but not quite, at the same point as the present London Bridge. It was probably of wood, standing on great piles driven into the bed of the river. There are several sections remaining of the wall they built round London, and "London Stone," still standing outside Cannon Street Station, against St. Swithin's Church, is supposed to be the point from which the Romans measured their great roads that ran out from Augusta, as they called the city, to all parts of Britain.

OWEN WHEELER.

[*E.N.A.*

A RAILWAY WHICH GOES TO SEA.

This great viaduct and others like it carry the Florida East Coast Railway across the sea to the island of Key West. Altogether a chain of 114 rocky islets, separated by water channels, is traversed.



[*Fleet Agency.*

H.M.S. "NEW ZEALAND" PASSING THROUGH THE PANAMA CANAL.

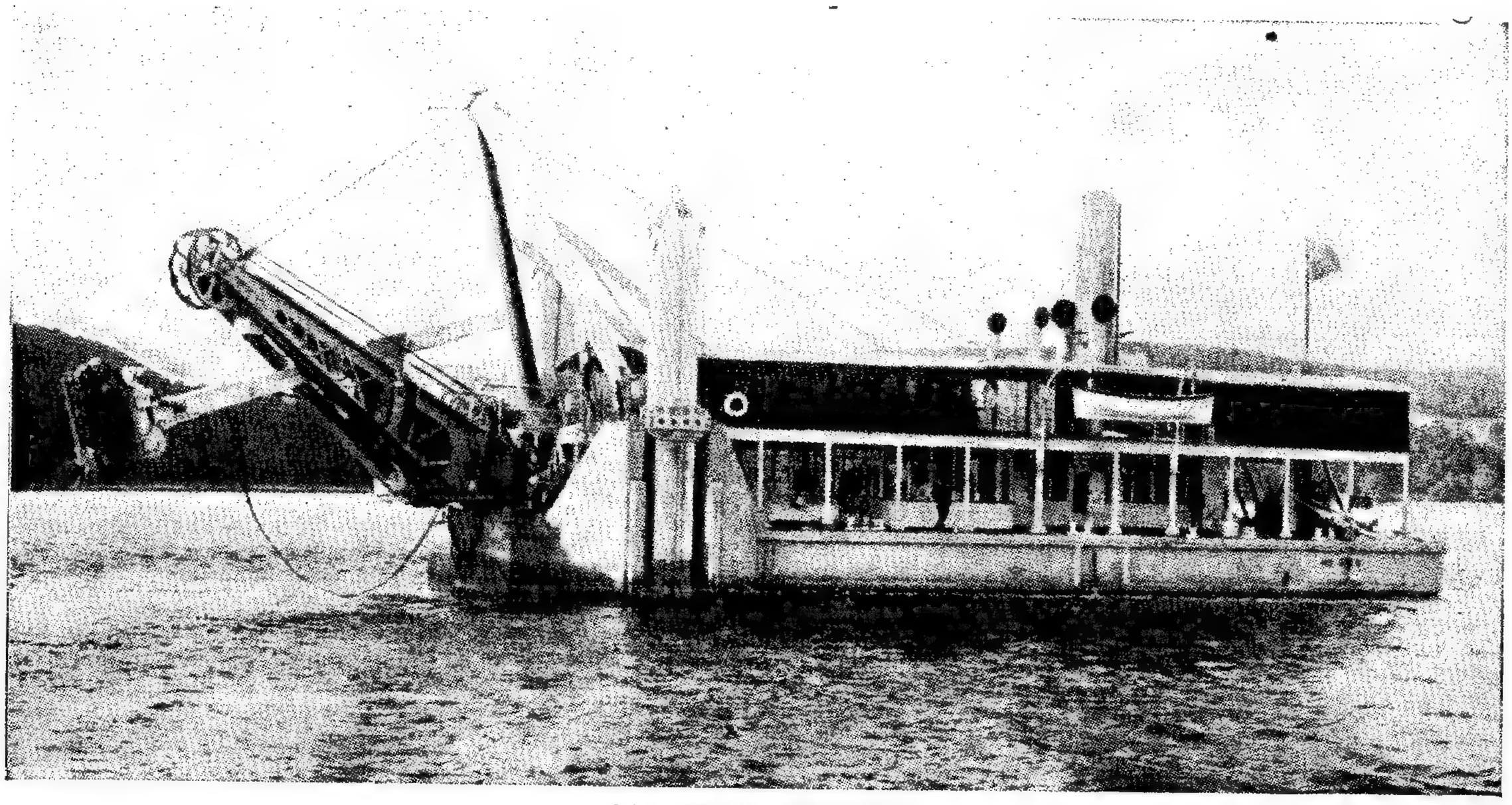
Some Wonderful Ship Canals

THE Roman Emperor Nero is best known on account of his cruelties, just as Napoleon is remembered because of his conquests, but both Nero and Napoleon were men of great ideas. It was Nero who first thought of cutting a canal through the Isthmus of Corinth in order to save ships the long journey round the south end of the Isthmus, but the task was too great for his engineers, and the canal was not cut until long after his time.

In 1882 a French company began work on the canal, but found it too much for them; the task was transferred to a Greek company, and under the direction of Matsas, a Greek engineer, the canal was finished in 1889. It is a straight ditch four miles in length and 72 feet wide, cut for the most part through solid rock. Two towns, Poseidonia at the western end (named after Poseidon, or Neptune), and Isthmia, at the eastern end, have sprung up in consequence of

the cutting of this canal, which ranks as one of the most useful artificial waterways of the world.

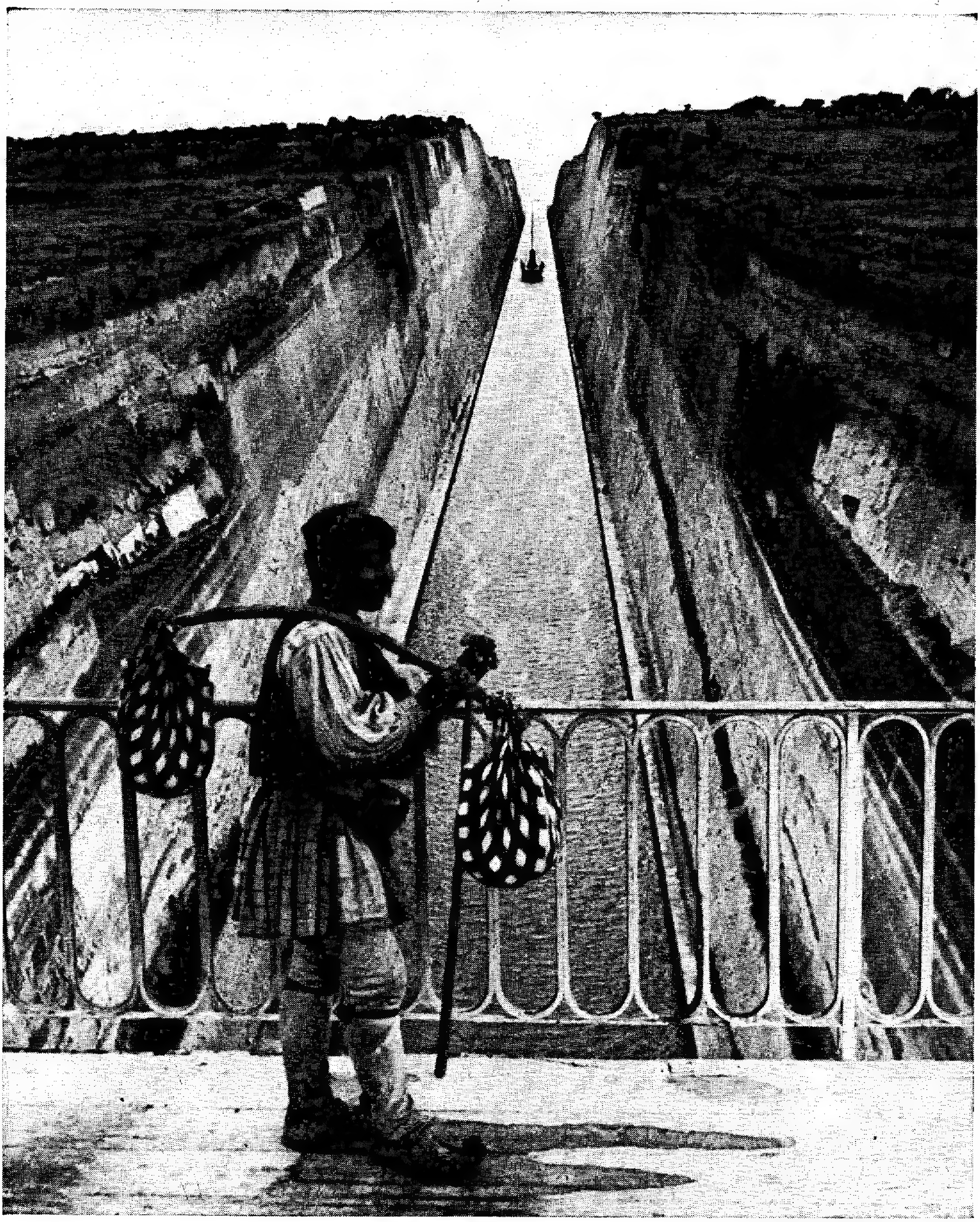
The oldest artificial waterway, probably, is the Suez Canal. Rameses II, one of the greatest of the early Egyptian kings, first cut a channel for boats from Cairo to the Red Sea, but in later reigns it was allowed to silt up with mud and sand. A second canal was cut by the Egyptian King Necho, who reigned 600 B.C., and this was deepened and finished about seventy years later by the great Persian monarch Darius. It was allowed to silt up again, and not cleared until, about a thousand years later, Amru, the Mohammedan king who led the Arab conquest of Egypt, made it available for boats.



A DIPPER DREDGER.
Used for clearing silt or mud from canals and the entrances to docks and harbours.

All these early attempts at making a canal were forgotten when Napoleon undertook the Egyptian campaign that followed his conquest of Italy. He immediately saw the value of such a canal as a near way to India, but the engineers whom he ordered to report on the matter thought its construction impossible, as by their calculations the level of water in the Red Sea was 30 feet higher than that in the Mediterranean. The engineer responsible for this misleading report judged it impracticable to construct locks to correct the levels of the two seas.

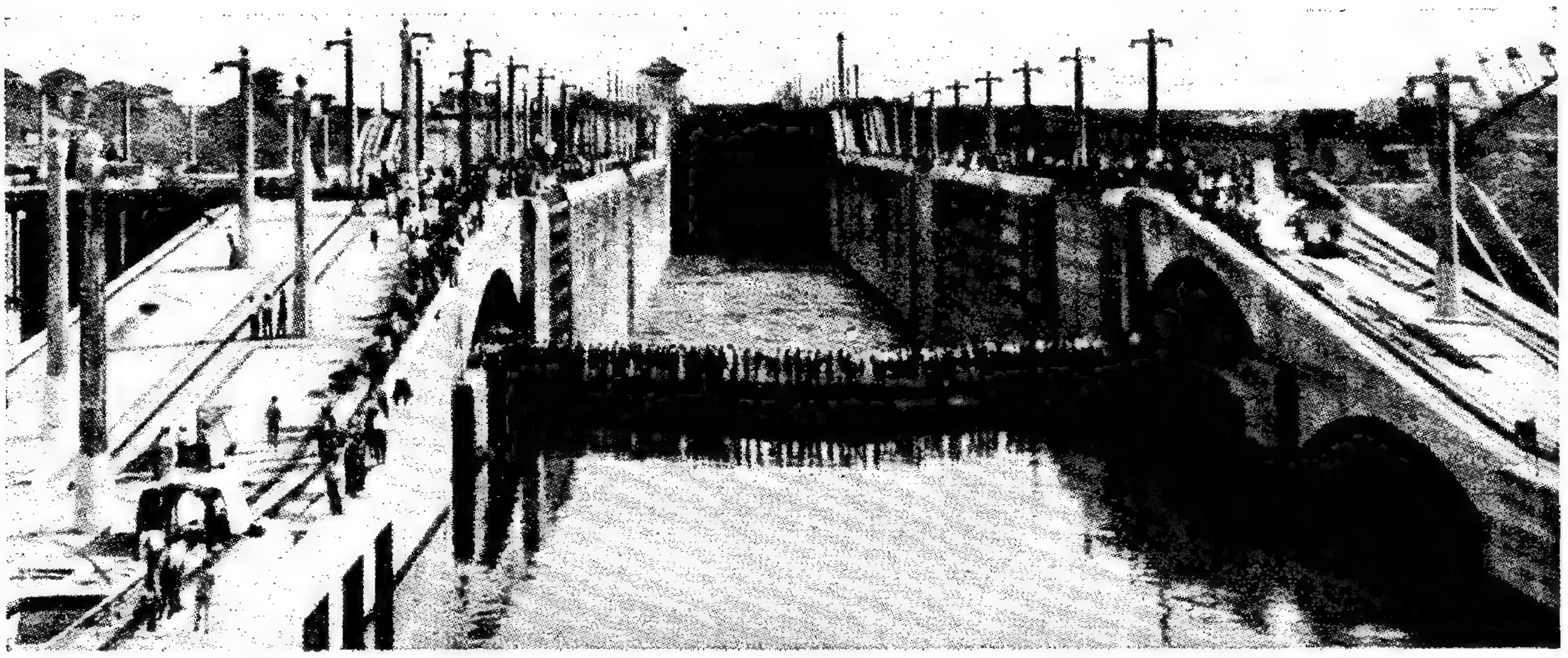
Later, English officers surveyed the route, and found that the French engineer had been wrong; there was no difference in the levels of the two seas, and therefore there was no need for locks.



[*Underwood & Underwood.*

LOOKING ALONG THE GREAT SHIP CANAL THAT CUTS THROUGH THE ISTHMUS OF CORINTH.

De Lesseps, the great French engineer, formed a company, and work was begun in 1859, nearly 30,000 men being employed. Various hindrances delayed the work, but the canal was finally opened in

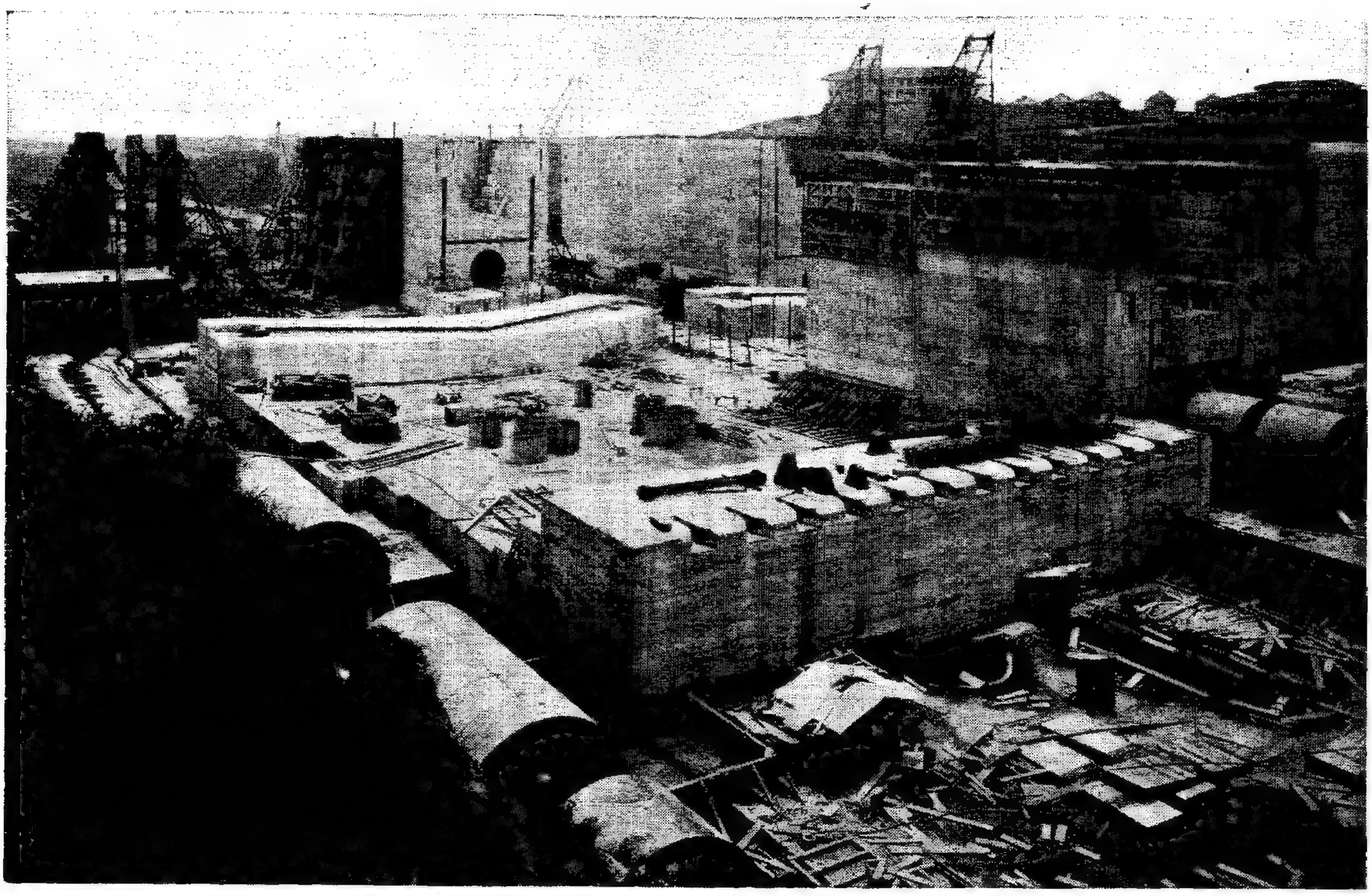


[*E.N.A.*

THE GREAT GATUN LOCKS, PANAMA CANAL.

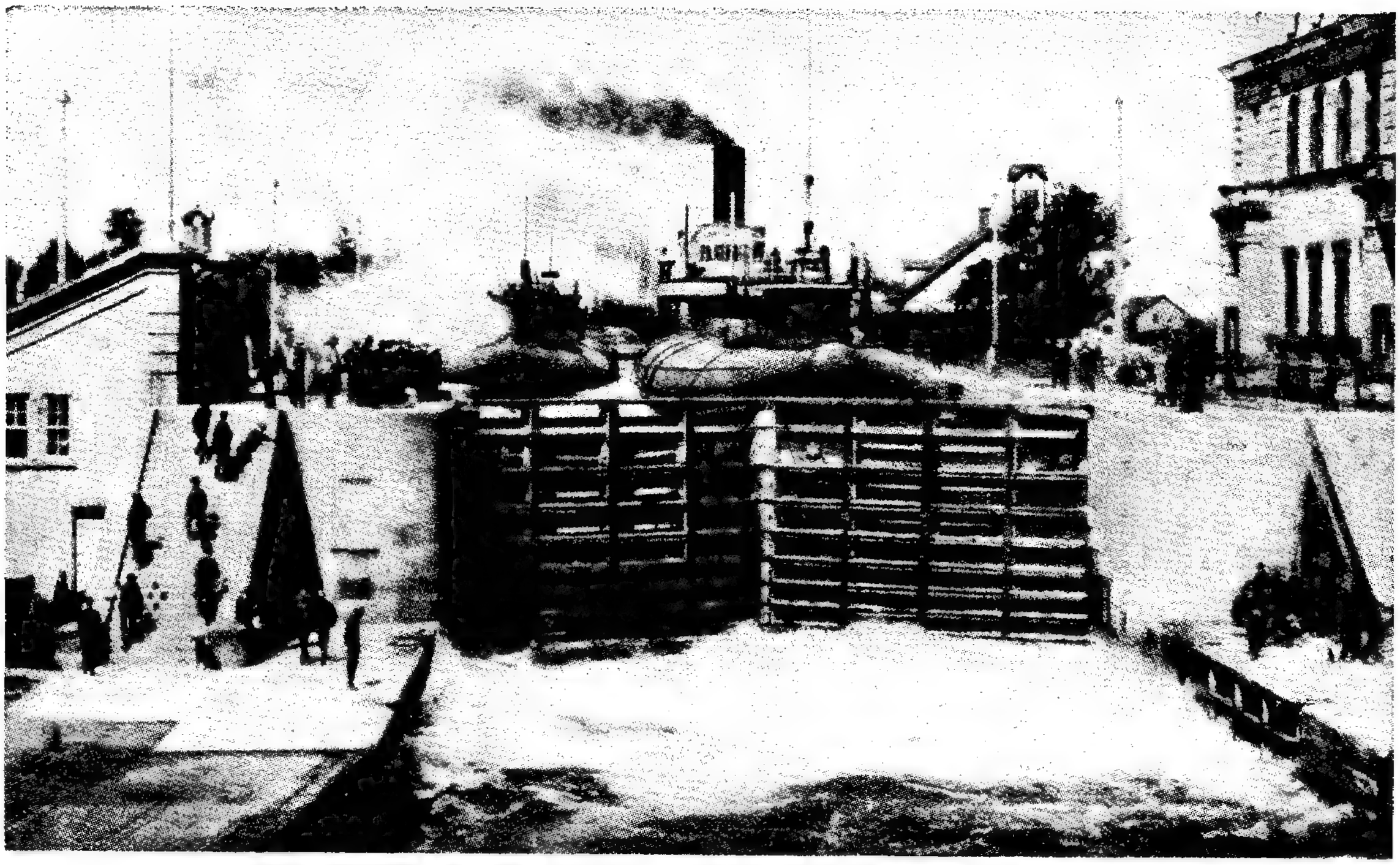
Over seventy men have found room on the lower gates to watch the water filling the lock.

1869, after having cost twenty million pounds. It is over a hundred miles in length, and was originally 26 feet deep, but it has since been repeatedly deepened, so that ships drawing 30 feet of water can pass through it now. From four to five thousand ships make the passage each year and the canal dues amount to very large sums. In recent



[*Fleet Agency.*

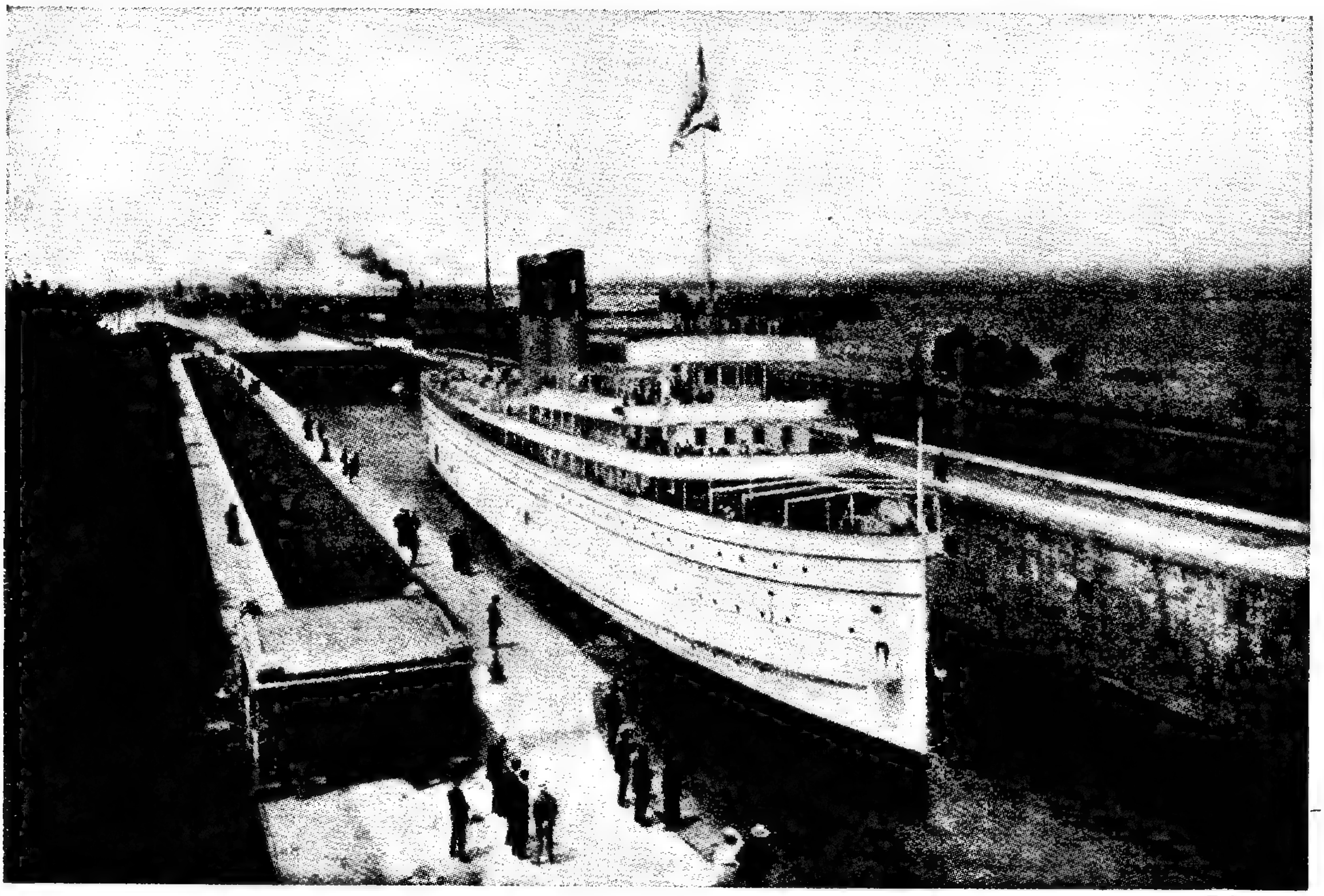
CONSTRUCTING THE GATUN LOCKS, PANAMA CANAL.



[*E.N.A.*

WEITZEL LOCKS ON THE SAULT STE. MARIE CANAL, BETWEEN LAKES SUPERIOR AND HURON.

The curiously shaped steamers are known as "whalebacks," and are used for carrying wheat.



[*E.N.A.*

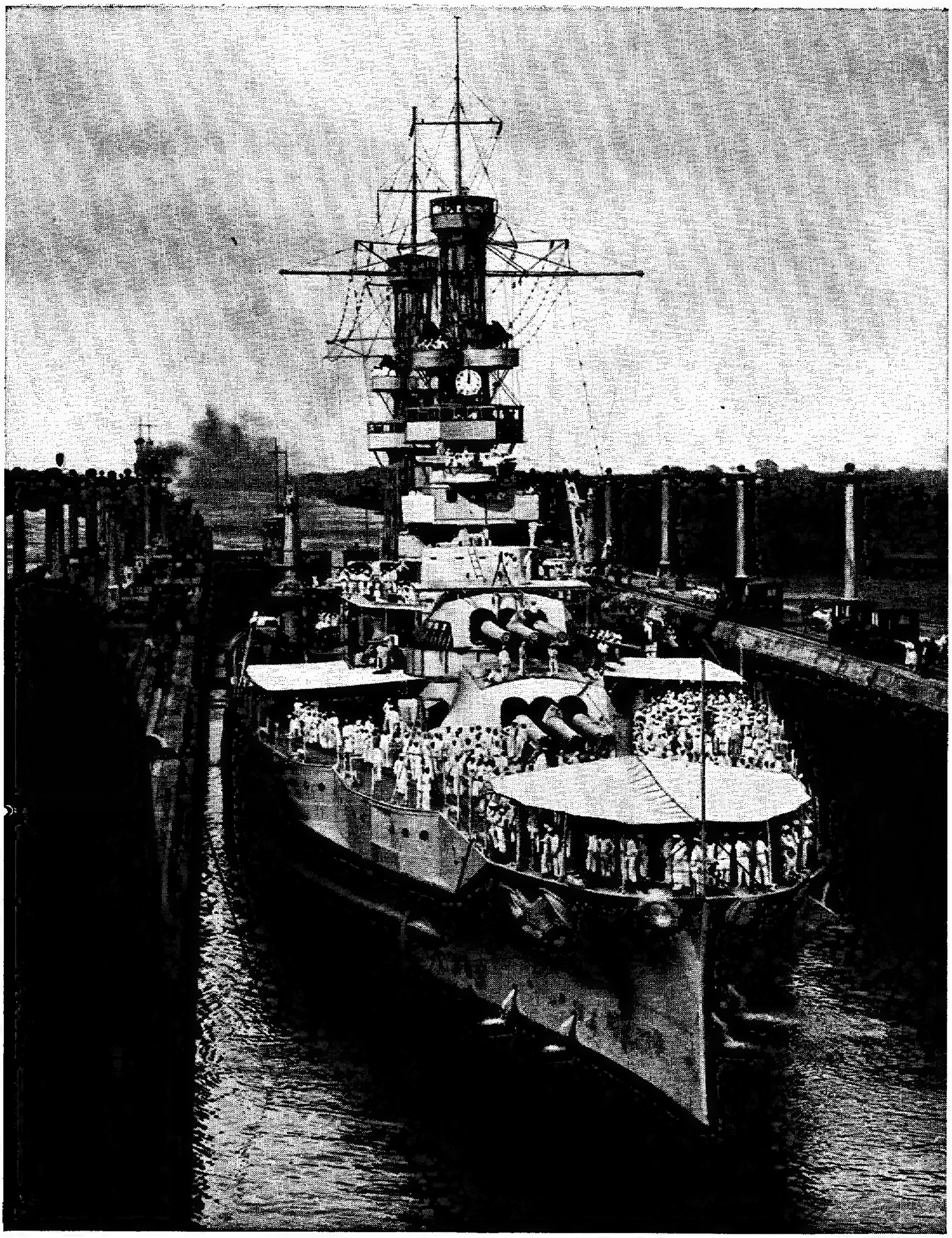
A PASSENGER STEAMER PASSING THROUGH POE LOCK, ONE OF THE LARGEST IN THE WORLD, ON THE SAULT STE. MARIE CANAL.

years electric light has been installed through it, so that the canal can be used by night as well as by day. The passage of the canal takes about 16½ hours.

The cutting of the canal was not a difficult task from the engineering point of view; the banks are nowhere more than 60 feet above sea-level, and the cutting is through sand, sandy clay, and hard rock; most of the difficulties were caused by the drifting of loose sand. The canal was led through the beds of lakes, which helped to lessen the work of cutting, though only eight miles or so were deep enough without further excavation.

It is said of the Panama Canal that it cost "a life for every foot," for the French company, under De Lesseps, who attempted the task first, reckoned without the mosquitoes which infested the canal region, carrying malaria and the deadly yellow fever. Although De Lesseps was the first to form a company and begin work, the idea of cutting a way through at Panama, so as to save ships the long voyage round Cape Horn, is nearly four hundred years old. The great Spanish explorer, Balboa, put forward a project for a canal to the then Emperor of Spain, thinking that it would save transporting the wealth of Peru, then a newly-discovered country, overland, and would give Spain command of the Pacific. Nothing was done, however, until the French company began operations in 1881, and the story of their work is one of the world's great tragedies. Men died off like flies, the administration of the company was so corrupt that there was more waste than work, and when 1,300 millions of francs had been spent the task was given up. Miles of railway engines, dredgers by the score, hundreds of tons of rails, and materials of every kind were left to rot, unused, in the tropical wastes of the Isthmus. The mosquito had beaten man and driven him out.

A new company, under American control, took up the work in 1889, the first task being that of making war on the mosquito. The fight was a long one, but the last epidemic of yellow fever took place in 1905, and in 1906 the last case occurred. Then construction began, steam shovels being used for the "dry" digging, and dredges for the "wet" work at the two ends of the canal. The canal was finished, with a depth of 40 to 45 feet, and opened on January 7, 1914; since then there have been a number of landslides which have interrupted the passage of ships from time to time, but these have been cleared away. It is said that the work will never be quite



[*Topical.*

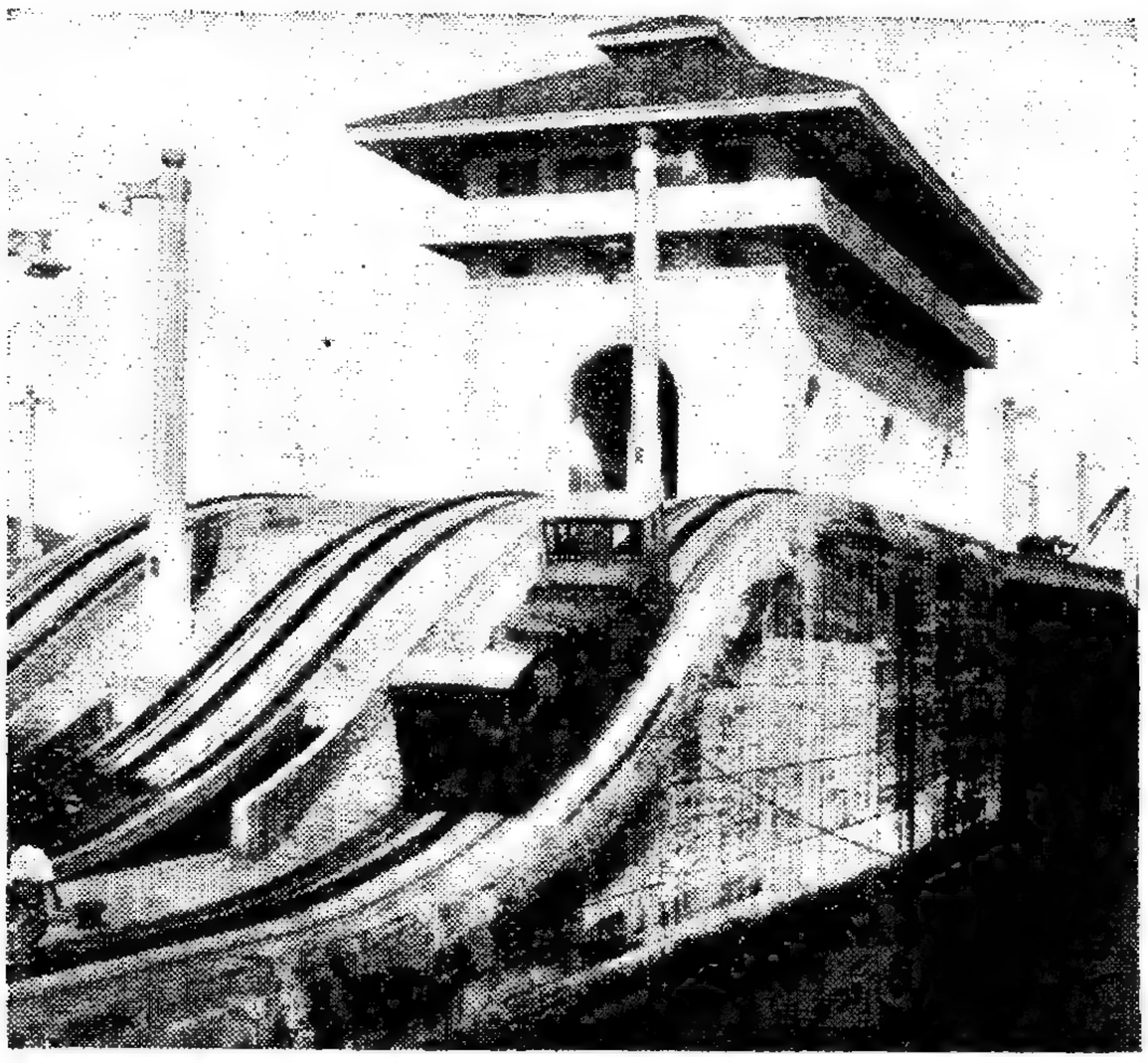
UNITED STATES WARSHIPS BEING TOWED THROUGH THE PANAMA CANAL.

secure, as in what is known as the "Culebra cut" (the most extensive excavation ever made) a mountain range pushes against the side of the canal, and thus landslides are always to be feared. Ships are towed through the canal by electric "mules," as shown in our pictures, heavy cars driven by electricity and running on rails alongside the waterway. The passage of fifty miles is made in less than ten hours, although it includes passing through some of the biggest locks in the world. About 3,000 vessels make the passage each year and the number is rapidly increasing. The Panama Canal is said to have cost in all about £75,000,000.

Another great system of canals is that which joins the great lakes of North America with the Atlantic Ocean. Here the drop in water level from Lake Superior to the sea is nearly 600 feet. The short Sault Ste. Marie Canal, connecting Lakes Superior and Huron, has the greatest locks in the world, and the system as a whole possesses the most wonderful machinery for the handling of ocean-going ships on their passage down from Lake Superior eastwards to the St. Lawrence river. Another great work is the Welland Canal, connecting Lakes Eerie and Ontario. It is twenty-five miles in length and has greatly altered the aspect of the Niagara peninsula. This important waterway is now being deepened and enlarged.

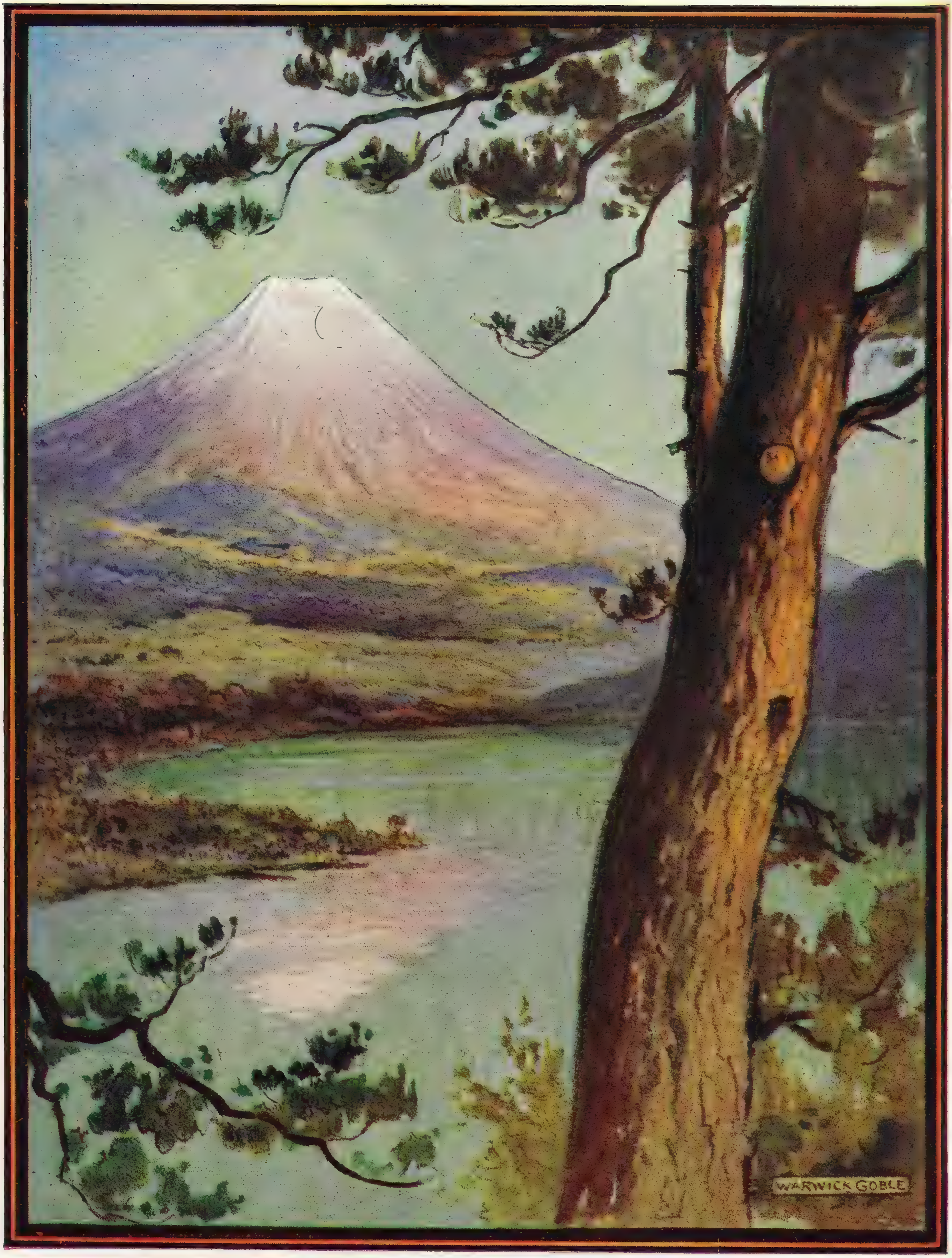
Other famous waterways are the Kiel Canal (61 miles), in Germany, of which we heard so much during the War, and the great Manchester Ship Canal ($35\frac{1}{2}$ miles), which now plays so great a part in the industrial life of the North of England.

E. CHARLES VIVIAN.



[*G. E. Huggett.*

One of the electric "mules" used to draw ships through the locks of the Panama Canal.



FUJI: THE WONDER MOUNTAIN OF JAPAN.

Fuji, the peerless, has in all ages been the favourite theme of Japanese painters and poets. It is 12,395 feet high and is snow-capped even in summer. Beautiful itself, it commands, under favourable conditions, an even more beautiful view, so that the ascent, though difficult and taking several days, is made by large numbers. There was a terrible earthquake here in 1923, resulting in the loss of thousands of lives and the destruction of large parts of Tokio and Yokohama.

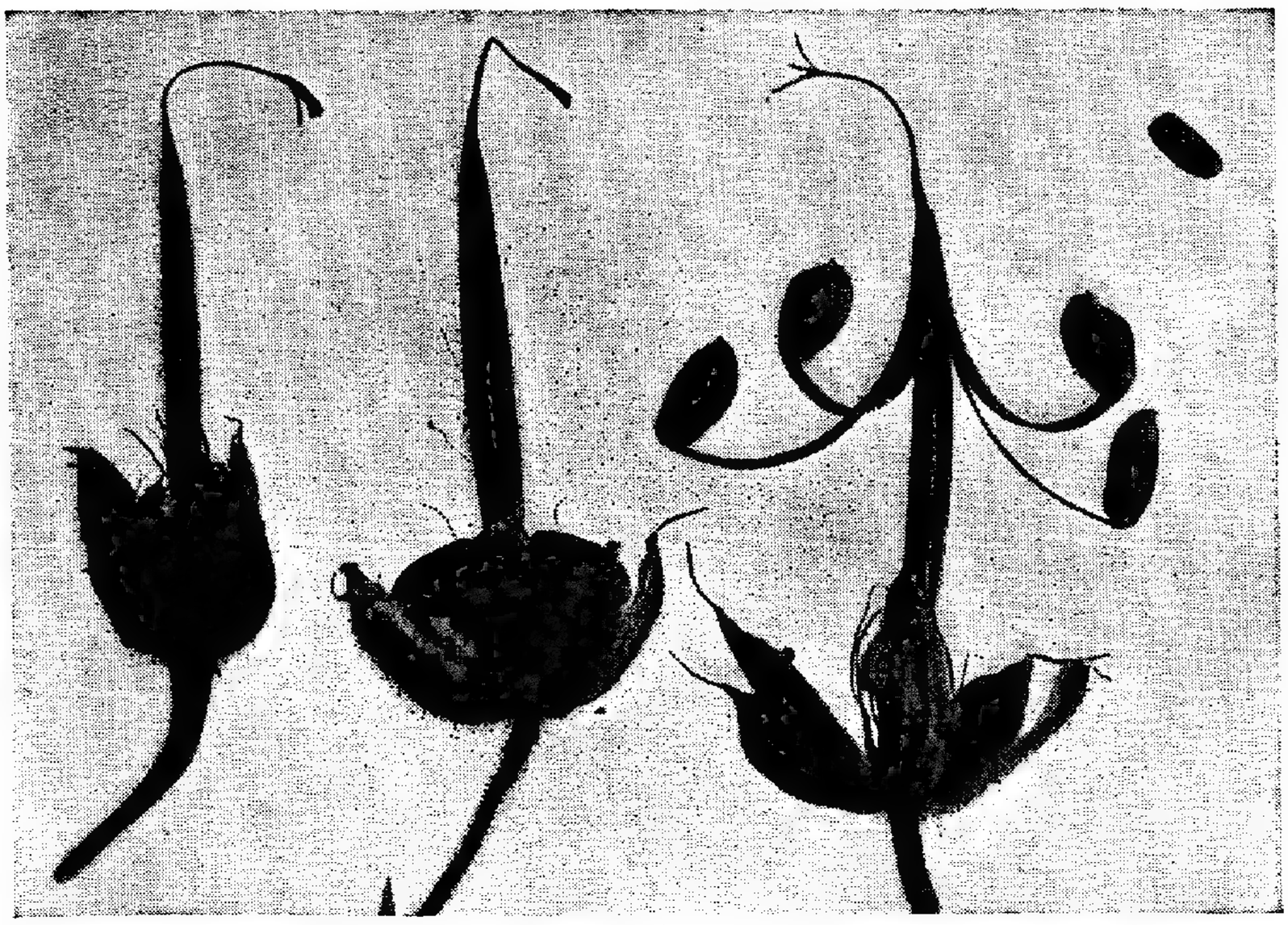


Photo by] *[Henry Irving.*

A MEADOW CATAPULT.

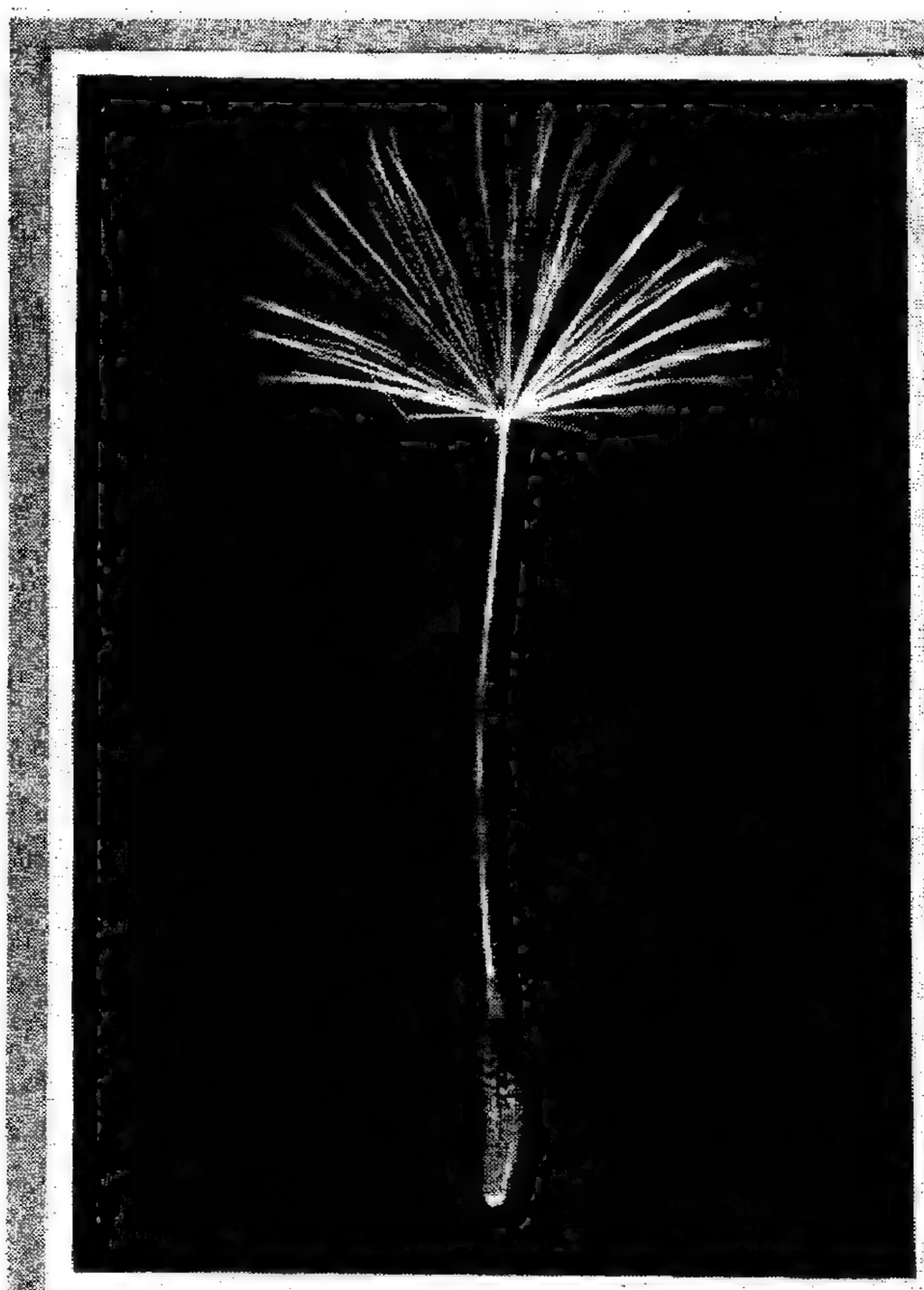
The Meadow Geranium disperses its seeds by a catapult action. 1. Fruit approaching ripeness. 2. The capsules containing seeds rise to a horizontal position. 3. Capsules spring up by a catapult action and the seeds are ejected, the capsules and spring remaining attached to the plant.

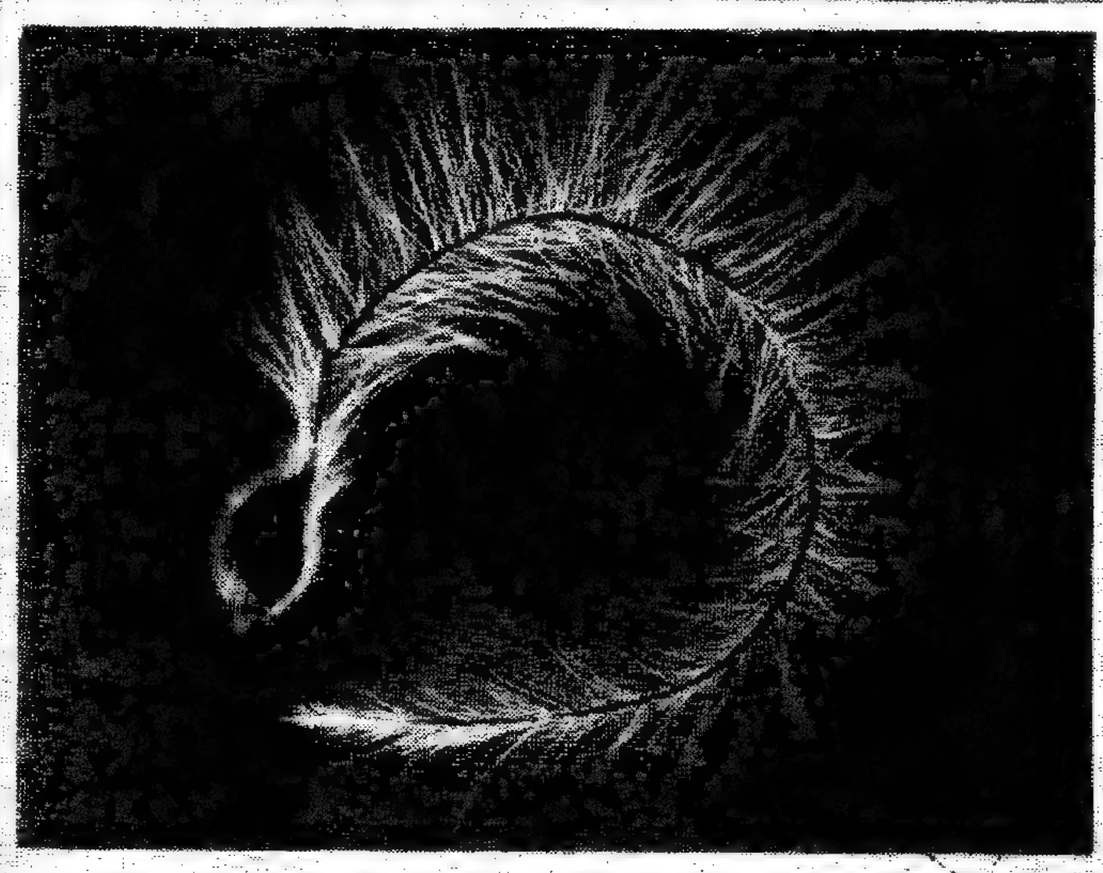
Seeds that Sow Themselves

PLANTS are very like people in one respect, that one of the great problems of the parents is to make sure that their offspring have a fair start in life. More than anything else seeds need room in which to grow and, in turn, to bear flower and fruit. So that we find the most wonderful devices adopted to make it likely that the seed, which is really a tiny plant wrapped in a packet, shall be carried some distance from the mother plant.

Have you ever watched a clump of thistles on a breezy autumn day and seen how the masses of down are borne gaily away on the wind? The fluffy substance, to which the seeds of the plant are attached, supports them in the air, and they probably will not settle down until they have travelled quite a long distance. When you blow to pieces a dandelion "clock" the seed vessels sail away on the prettiest little parachutes you could imagine. In some cases seeds are attached to wing-like expansions which help them to get away from their parent. Several common trees, such as the elm, sycamore and the maple, are cases in point. A curious Californian fir known as Coulter's Pine has a large wing attached to the heavy fruit. By a clever arrangement, the seed is at once dropped to the ground should the flying device come suddenly into contact with

WONDERFUL SEEDS





Photographs by] [*Harold Bastin & Henry Irving.*

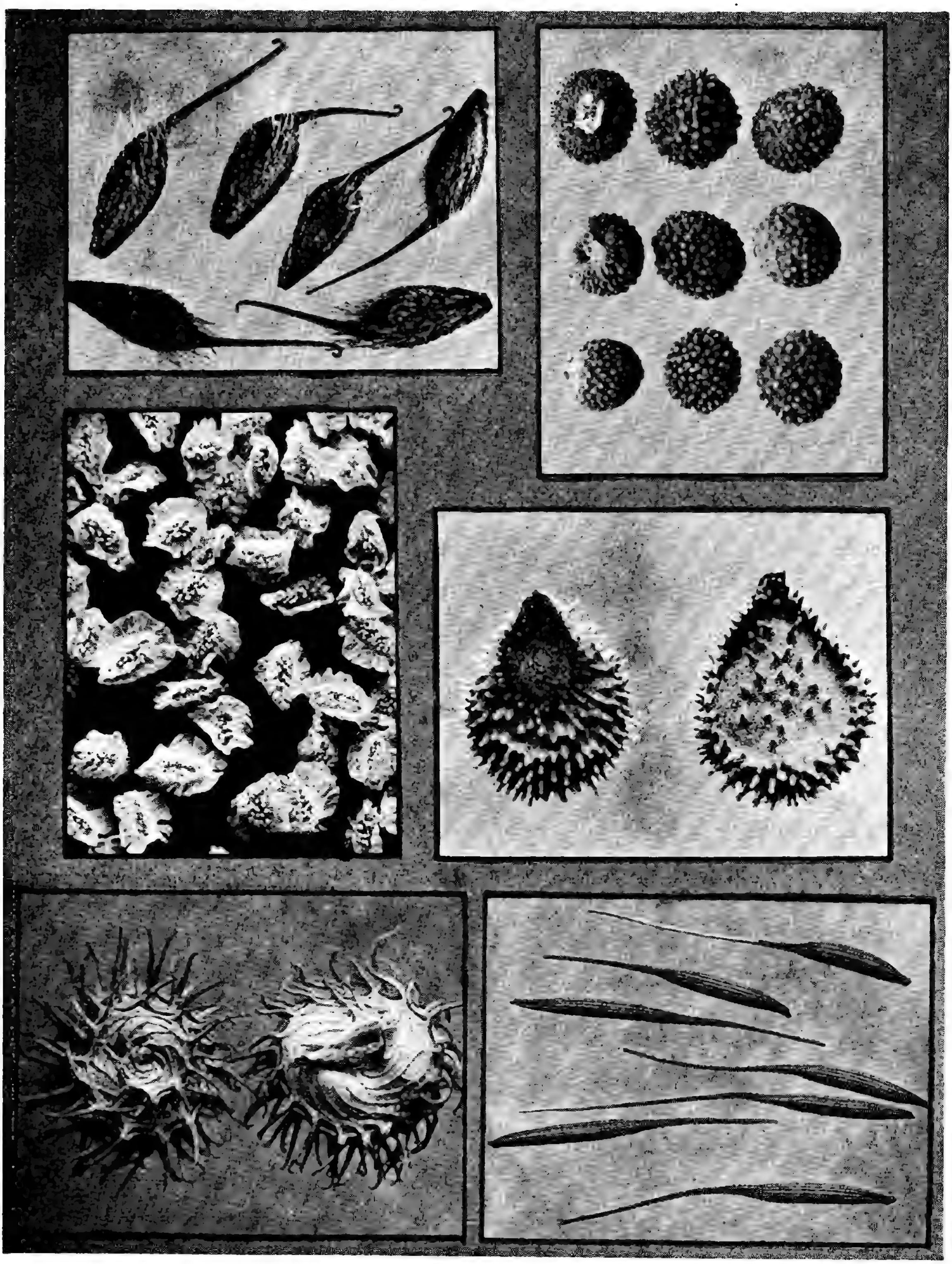
1. Seed of the common Dandelion. This is constructed on the principle of the parachute. The long stalk enables the seed to drop into a crack in the ground, and when this happens the upward-pointing hooks, or teeth, on the seed prevent it from being drawn up again. In fact, this seed knows not only how to fly but how to anchor itself to a suitable spot in which to germinate.

2. Ripe pod of Willow Herb immediately after bursting.

3. Feathered seeds of wild Clematis (Old Man's Beard).

4. Wild Clematis seed more highly magnified.

WONDERFUL SEEDS



Photographs by] [*Harold Bastin.*

1. Common Avens, or Herb Bennett. Note the hooks by which the seeds get attached to the fur or wool of animals.

2. Seeds of Nemesia (garden).

3. Seeds of the Toothed Medick, typical of those weed seeds which by their hooked projections get carried about in the hair of animals.

4. Cleavers, or Goose-grass.

5. Prickly seed vessels of the Hound's Tongue.

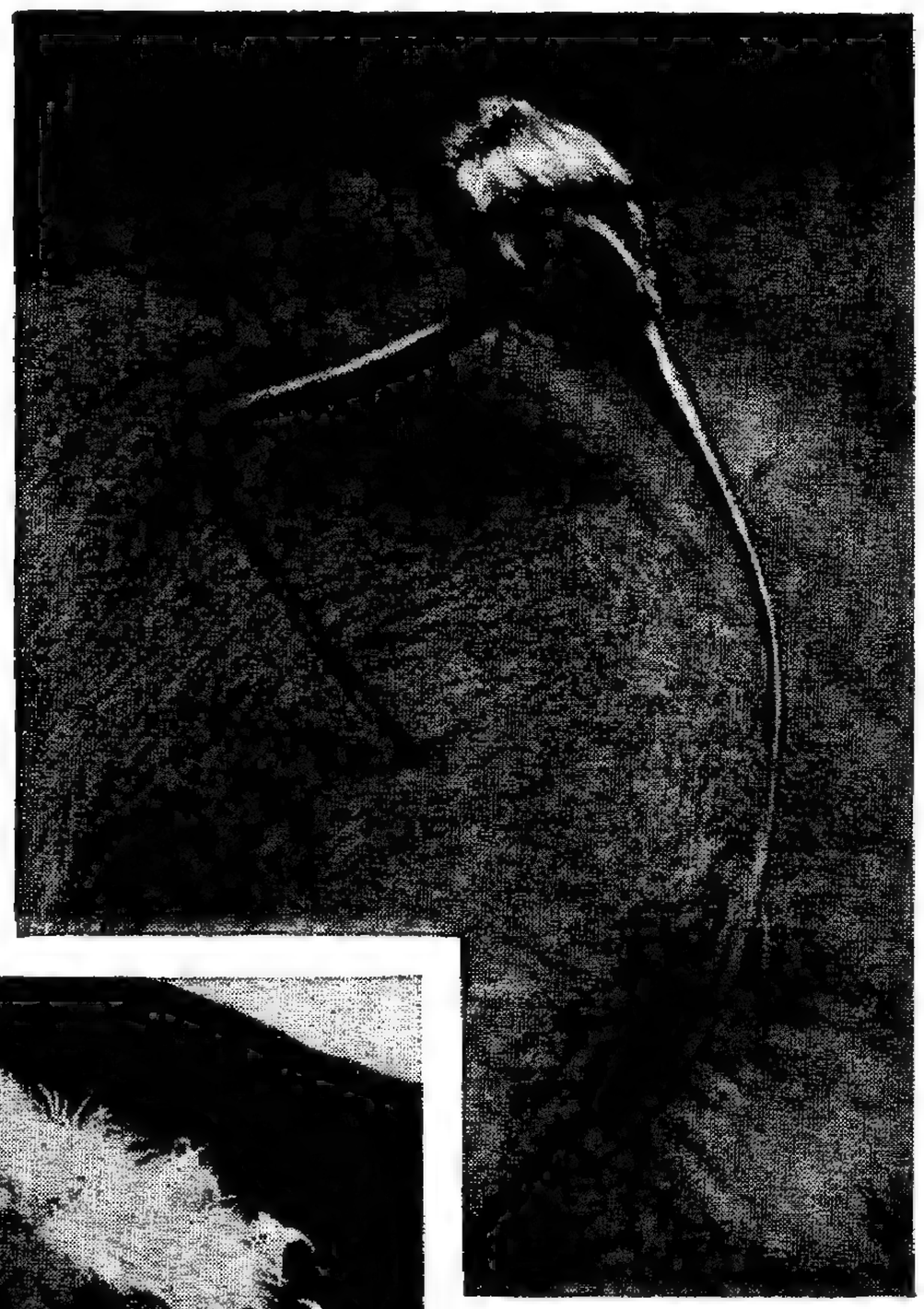
6. Cat's Ear seeds. The beautiful parachute-like attachments have been broken off.

anything like a tree branch. The whole idea resembles bomb-dropping from aircraft except that, instead of a destructive bomb, there is the useful seed of a tree.

Quite a lot of plants contrive to have their seeds dispersed by water. One of the most remarkable instances is that of the coco-nut, which, protected by a mass of fibre, floats for hundreds of miles on the sea. If it were not for the fact that the coco-nut palm will grow only in hot countries, the tree would long ago have been established all over the world. Coco-nuts have been carried from the West Indies, right across the Atlantic to the coast of Norway, where, if it were not for the cold climate, they would grow up into palm trees.

Animals, too, play a great part in distributing seeds. All kinds of clever plans have been adopted, such as putting the seed in some sweet and attractive fruit. Even if the whole fruit is eaten by the animal, the seed will withstand the digestive juices and, whenever it reaches the ground, will be able to grow. In other instances, the seed is attached to cases bearing hooks, which seize hold of any passing animal. The South African grapple plant, shown in our picture, is a notable instance. Here the hooks are large and curved. Living-stone reported that even lions are at times killed by getting the grapple fruits en-tangled in their mouths.

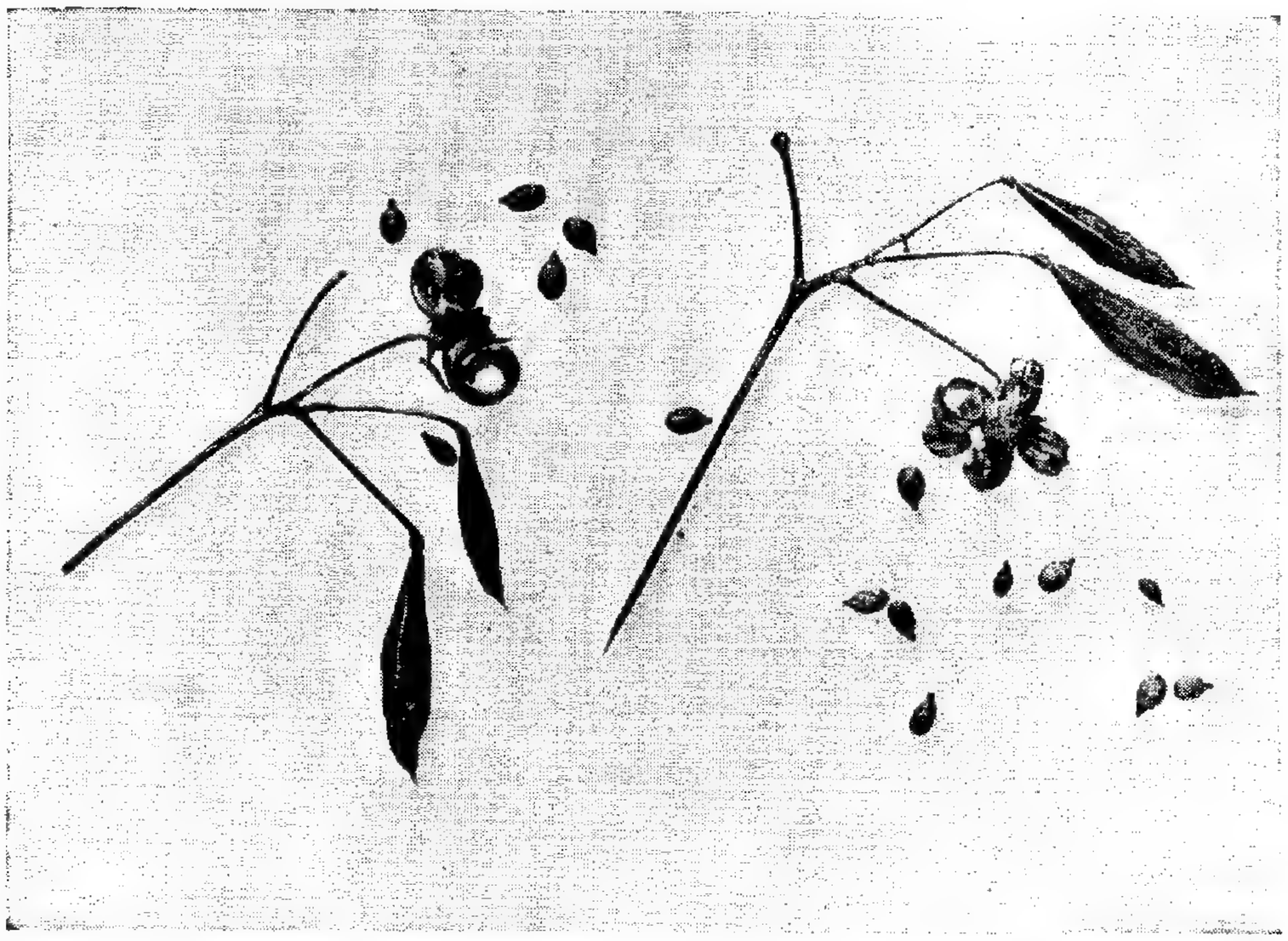
Every bit as cruel are the fruits of the South American Martynias. These bear two enormous curved hooks, which plunge into the flesh of an animal that happens to be pass-ing. Often, it is said, the poor crea-ture will yell with pain, and it may be weeks before the fruit is finally dropped. All this time the animal



MARTYNIAS FRUIT ATTACHED TO BODY OF AN ANIMAL.

[S. Leonard Bastin.

FRUIT OF GRAPPLE PLANT ATTACHED TO DOG'S FOOT.



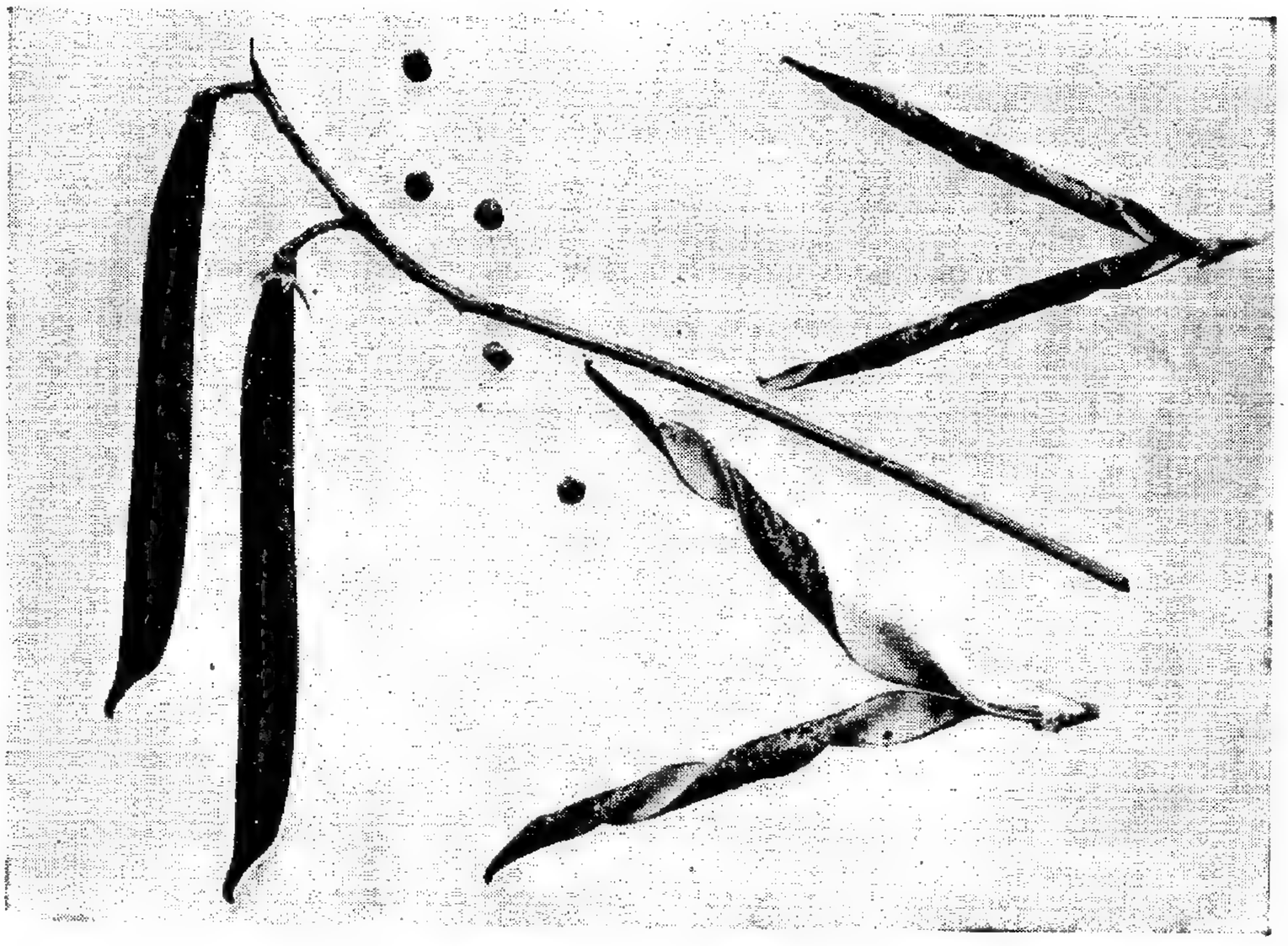
[*Henry Irving.*

CAPSULES OF WILD BALSAM EXPLODING AND SCATTERING SEEDS.

will be wandering about, so that the seeds are certain to be carried a considerable distance, and this is just what the plant wants to happen.

Most of us have been amused by the garden balsam, which produces seed vessels that, when touched, shoot out their contents with a good deal of force. More astonishing is the tropical sandbox tree which bears its seeds in a large capsule. As the case dries, it is in a state of considerable tension and eventually bursts, hurling the big seeds in all directions. The force with which the seeds are sent is so great that passers-by have often been badly injured.

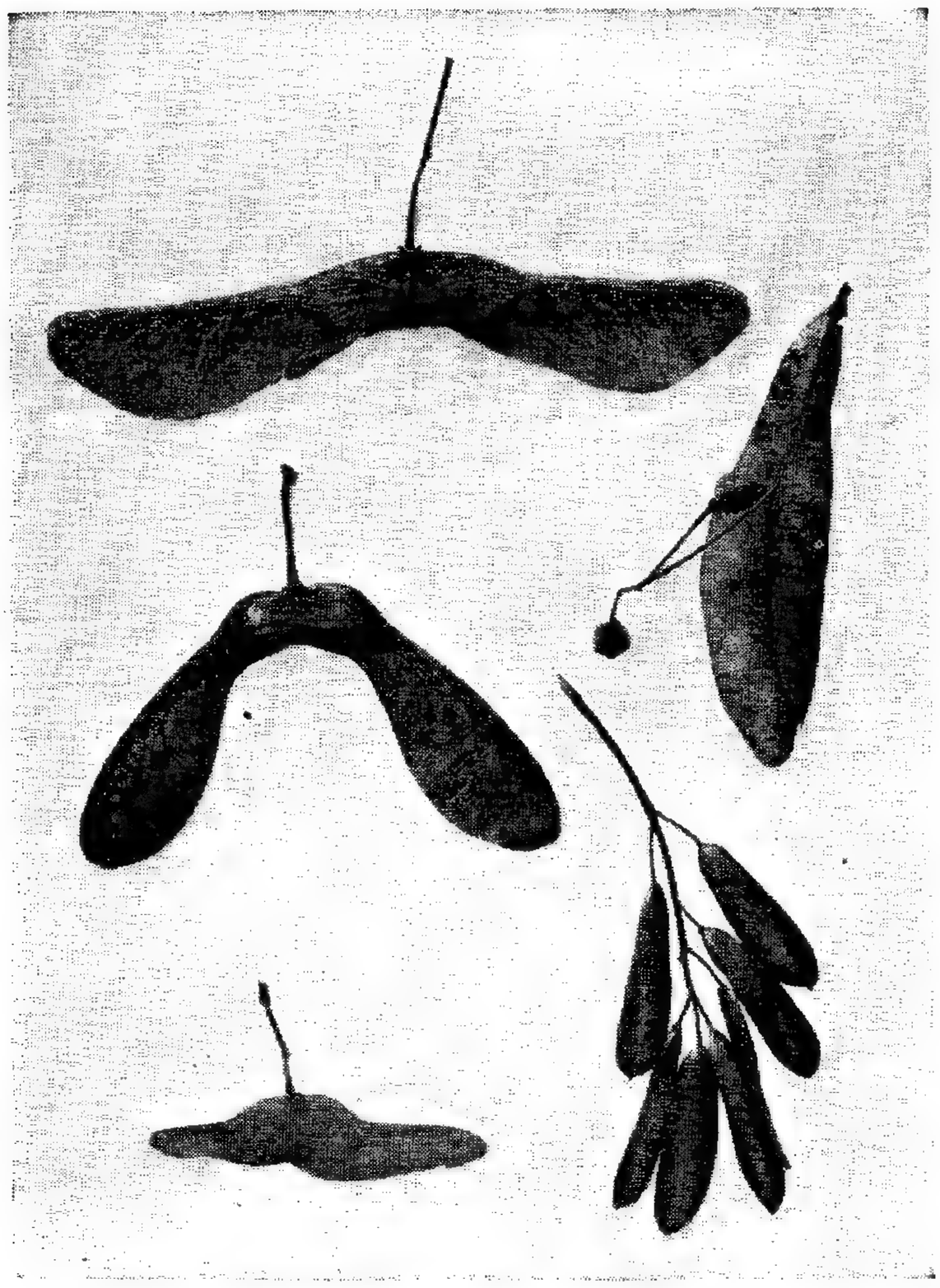
The production and dispersal of seeds is not the only method by which plants increase their kind. A very interesting fern is the North American Hartstongue. This plant is sometimes known as the "Jumping Fern," owing to its curious mode of propagation. At the tip of its long fronds baby ferns appear, and, as these grow, the leaf bends down and at last touches the soil. Here the small ferns take root and quickly grow into large specimens.



[*Henry Irving.*

PODS OF PERRENIAL PEA SCATTERING SEEDS.

SEEDS THAT SOW THEMSELVES



[*Henry Irving.*

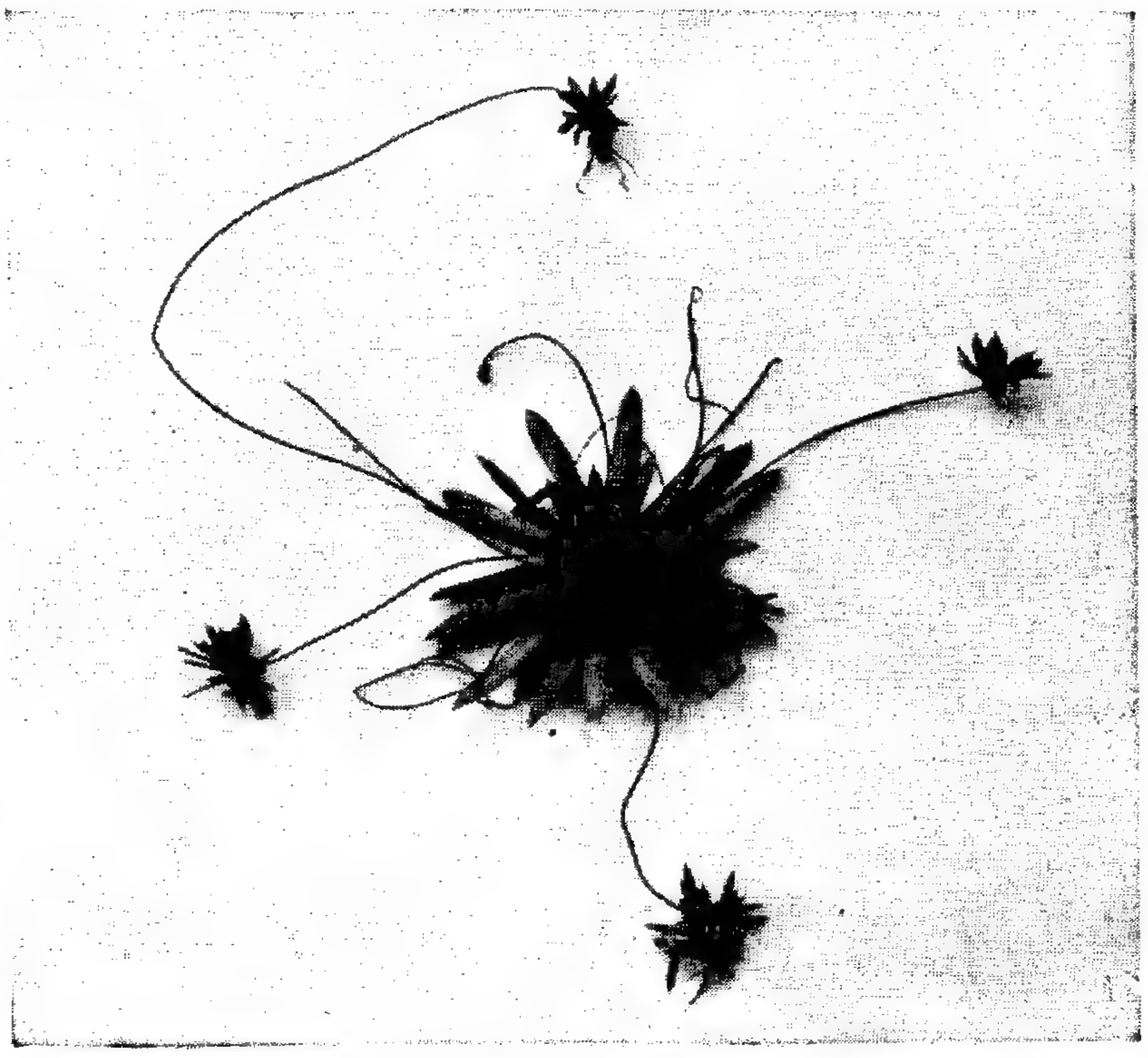
SEEDS WITH WINGS.

Norway Maple. Lime.
Sycamore. Ash.

Another curiosity is the Candle Plant (Kleinia) of South Africa. This species, which has succulent stems, like candles in shape, increases its kind in a most remarkable manner. At certain seasons of the year many of the stem joints break, and whole pieces of the plant fall away. Quite likely they may roll some distance from the plant but, wherever they settle, they will take root. Some of the cacti adopt a similar plan of distribution.

Among water plants this habit of breaking off fragments as a means of propagation is quite common. Any little scrap of watercress that is whirled away by the stream stands a good chance of taking root on the first mud bank where it comes to rest. A remarkable instance of the way in which a water plant is distributed is afforded by a North American weed known as Elodæa. This species was introduced into Great Britain, in some unknown way, some three-quarters of a century ago. Now it is found in almost every river, canal and stream, sometimes blocking up the waterways to such an extent that it is almost impossible for boats to get along.

S. LEONARD BASTIN.



[*S. Leonard Bastin.*

SAXIFRAGE BEARING SMALL PLANTS AT THE ENDS OF ITS STEMS.

[S. Leonard Bastin.

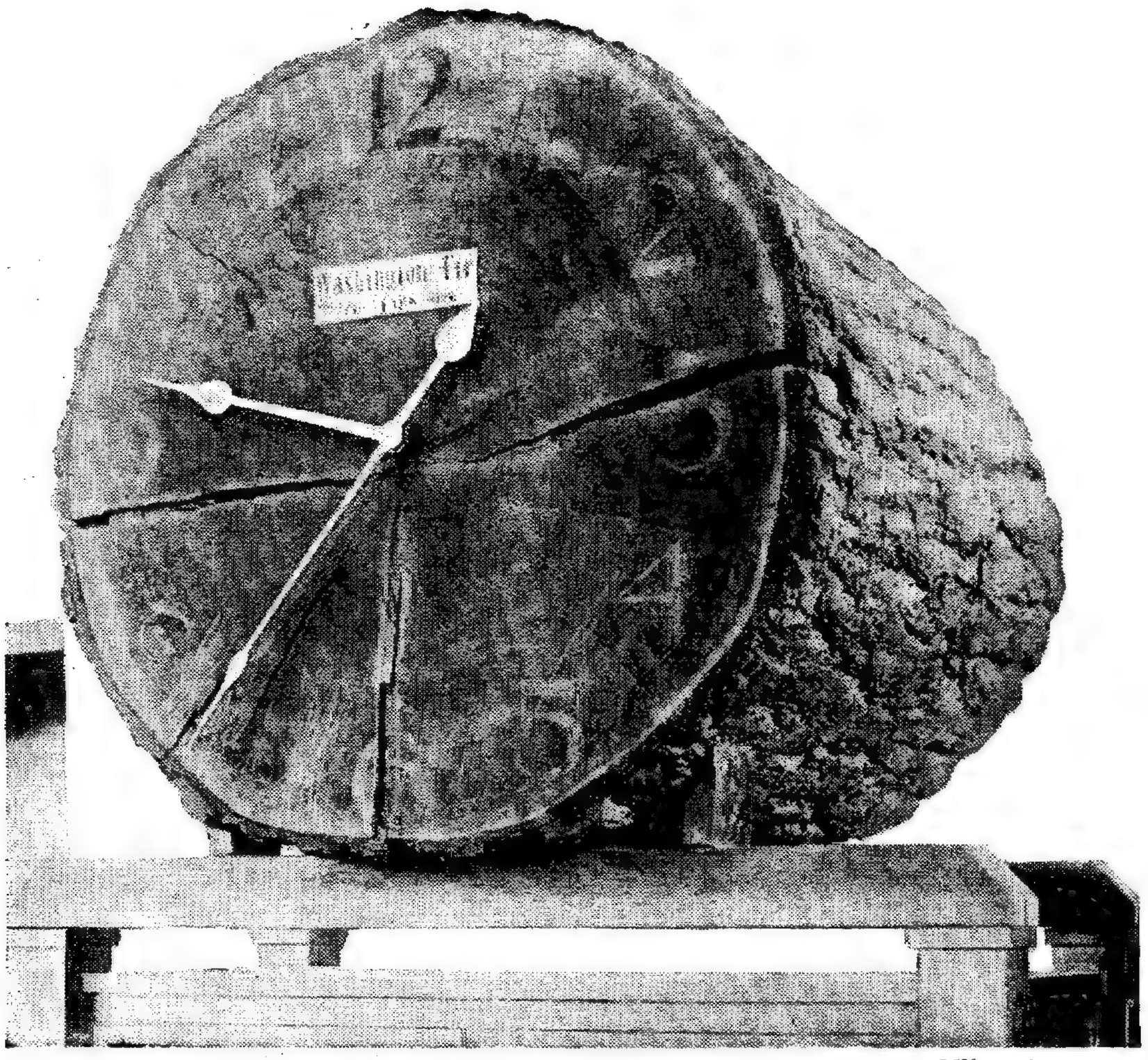
CANADIAN JUMPING FERN.

So called because it progresses, or "jumps," by rooting fresh plants at the ends of the fronds.

[S. Leonard Bastin.

JAPANESE JUMPING LILY.

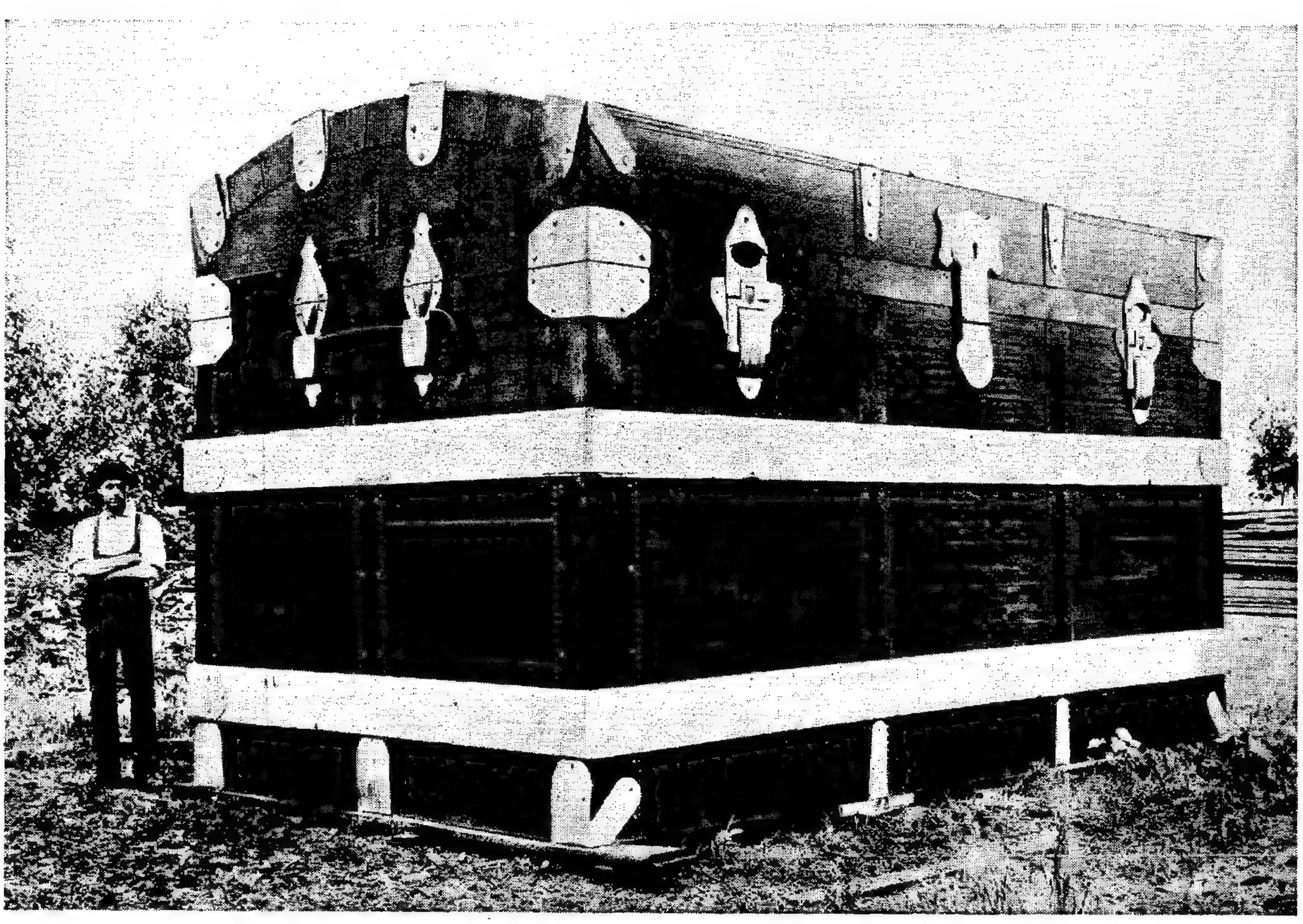
New plants are borne on the stalks.



[*Fleet Agency.*

A CLOCK IN A TREE TRUNK.

This clock, at the end of a very old fir log, has kept perfect time for years.



[*Fleet Agency.*

THE LARGEST TRUNK IN THE WORLD.

This trunk, exhibited at Dakota, was 18 feet long, 10 feet 6 inches high, and 10 feet wide. How your mother would love to pack that trunk and the porters to carry it!

Photo by] *[A. Blackie.*

NATURAL SCULPTURE.

A weather-worn rock in Corsica. Is it a hippo, a crocodile, or a camel-like ox? Nature has even remembered to dot the eye.

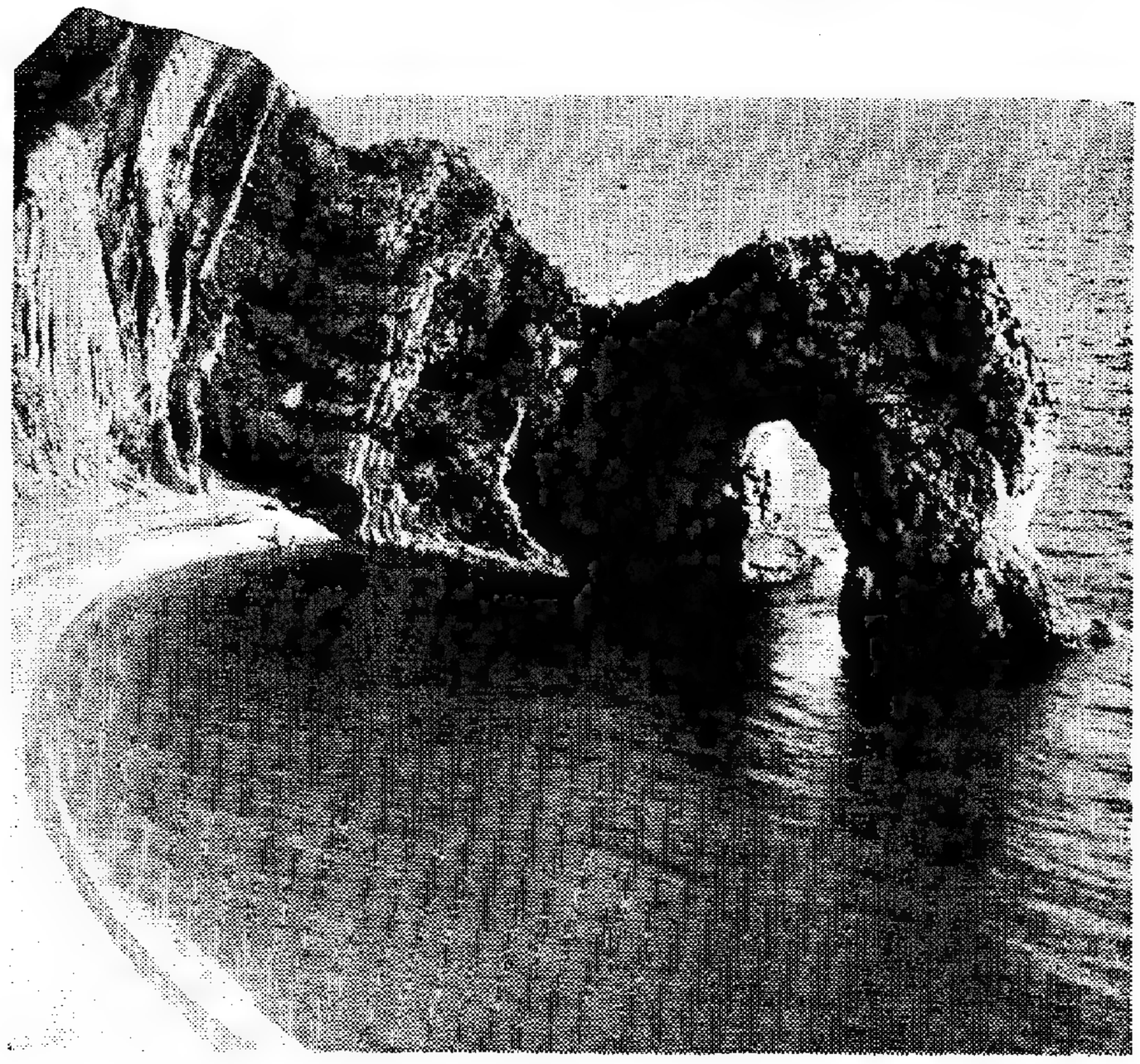
Nature as Carver:

Some Wonderful Rock and Cliff Formations

ALL over the world, as our pictures show, Nature has played such wonderful tricks with rocks and cliffs that it is difficult to believe the carving has not been done by the hand of Man. Some of these natural formations are very beautiful; others are grotesque and even funny, as is the case with the "dancing bear" and the monkey-faced rocks on the Yorkshire moors.

One of the most remarkable human likenesses in stone is the Mark Twain rock in Vancouver Island, British Columbia. The profile is an almost perfect representation of the great humorist, indulging in a hearty laugh. Then there is a rock in Corsica, shown in our photograph, which has been shaped by weather into an animal's head, even the eye of the beast having been properly placed. The toad rock at Tunbridge Wells is another well-known example of the curious effects of weather on stone, and in various parts of England, particularly Cornwall, "rocking-stones" are to be found, great masses of rock so poised that, although they weigh tons, they may be rocked by hand.

Some of the natural arches formed by water are especially beautiful: the most famous of all, and perhaps the finest, is the rock-arch of Matsushima, in South-Eastern Japan. The sea has eaten away the



[*Valentine & Sons, Ltd.*

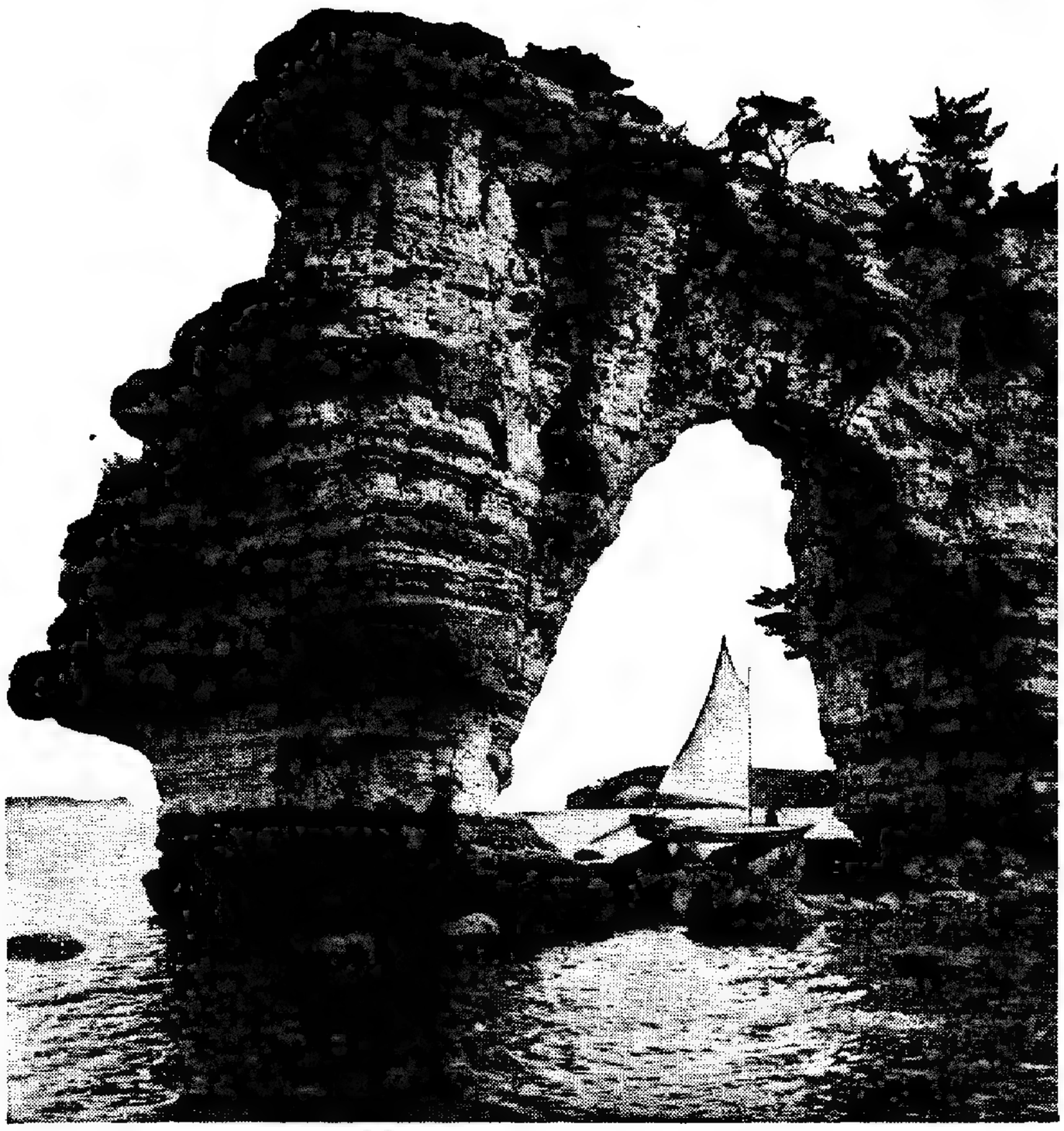
DURDLE DOOR,
a famous natural archway near Lulworth Cove, Dorset.

earth and soft rock from among the harder layers, producing a great natural archway which is as perfectly formed as if it had been laid stone by stone, instead of having been beaten into shape by the waves.

In the United States are upwards of fifty of these natural arches or bridges. One of the most famous is that of Virginia, illustrated on page 145. This natural arch has been described by a great American as "a bridge not made with hands, which spanned a river, carried a highway, and made two mountains one." The natural bridge in Japan has the beauty of the sea about it, but the Virginia arch is far inland, set in a magnificent natural park, and it actually has a road running over it, forming a bridge across the James River in a single span of 90 feet.

One of the best-known formations of this kind in England is the "Durdle Door" of Lulworth Cove, a natural arch at the south end of the little bay. This, again, is set in beautiful scenery, and is well worth a tramp over the cliffs to see.

One of the most remarkable natural rock formations in existence is the famous "Giant's Cause-

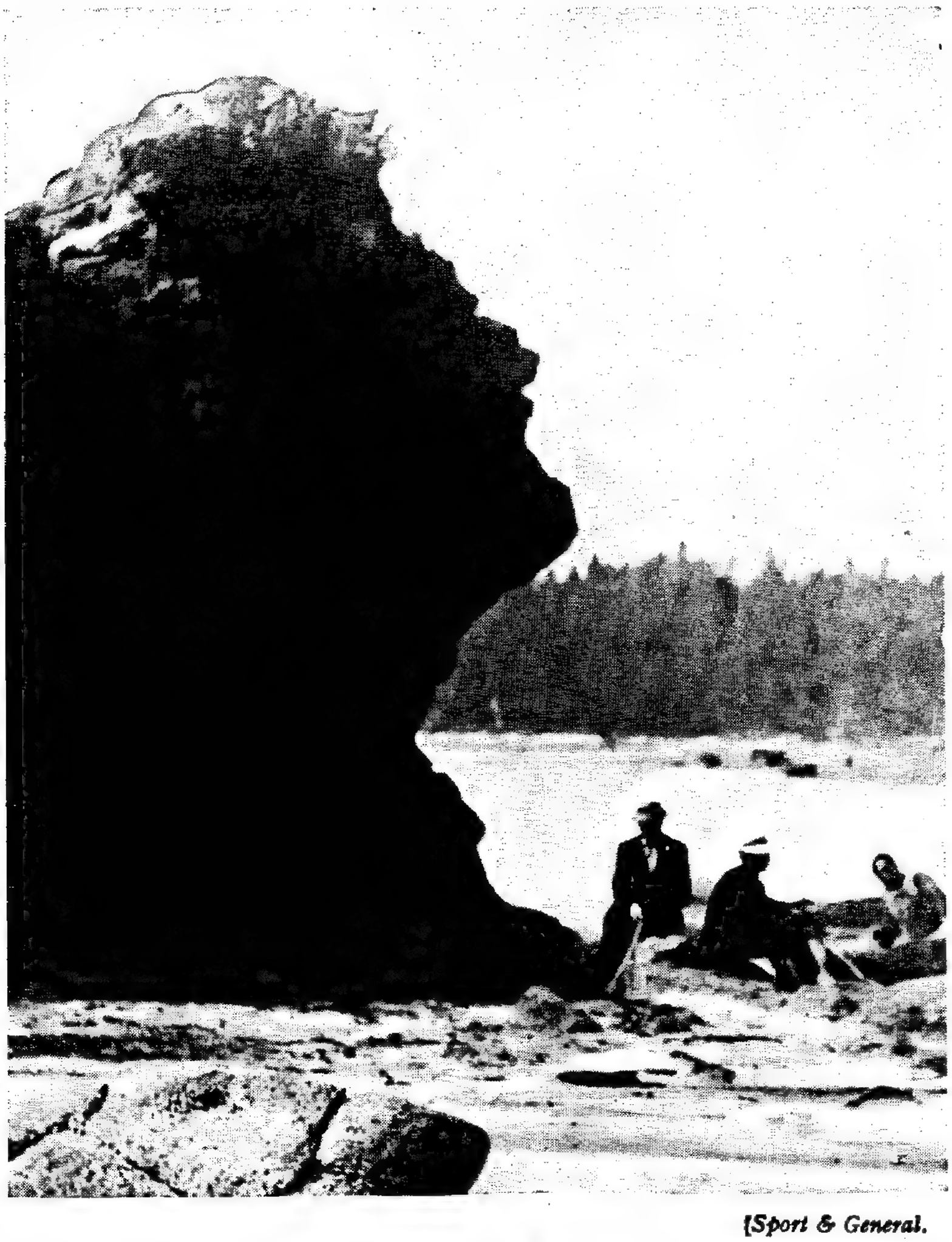


[*Underwood & Underwood.*

CARVED BY WAVE AND WIND.
A beautiful rock-arch, Matsushima Bay, Japan.

way " on the north coast of Ireland, with an immense number of hexagonal rock pillars broken off short and set close together on end.

The Neuquen territory of Argentina has several strange rock formations, including a fine natural arch through which is gained a beautiful view of the hilly country beyond. More to the east, in the province of Buenos Aires, is one of the biggest rocking-stones in

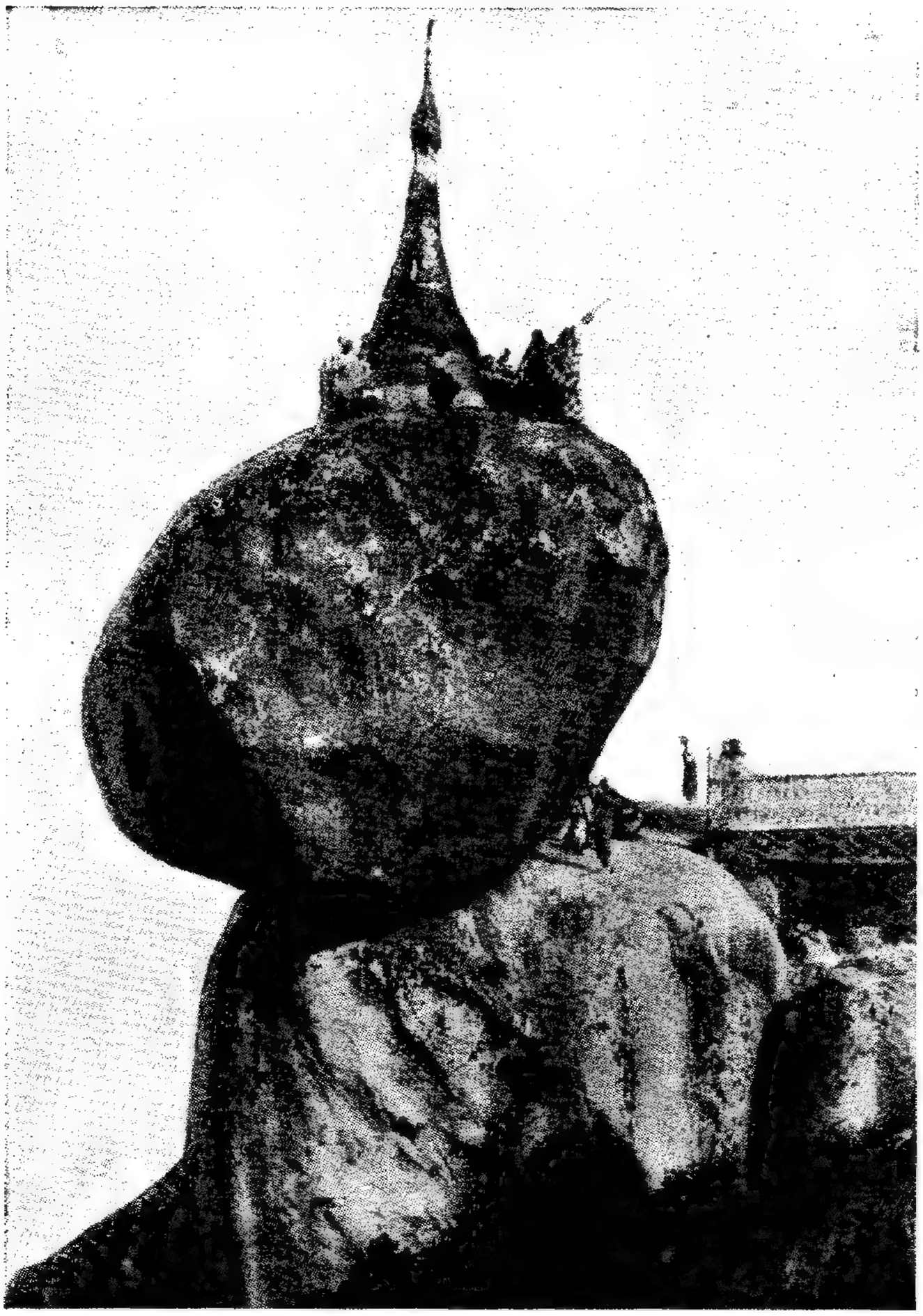


[Sport & General.

MARK TWAIN ROCK.

This rock, at Vancouver Island, bears a most remarkable resemblance to the great American humorist.

existence, a great mass, scores of tons in weight, balanced on a sloping surface in such a way that it seems as if the slightest touch would send it tumbling down. As a matter of fact, although it is possible to rock the stone slightly by pushing against it, the balance is perfect, and though the great mass will sway it is impossible to overbalance it. As our picture shows, the weight on the higher edge is considerably



[*E.N.A.*

A ROCKING PAGODA.

The pagoda is perched on a rocking-stone, on a lofty range of hills in Burma. It sways with every strong wind, but is apparently quite secure.

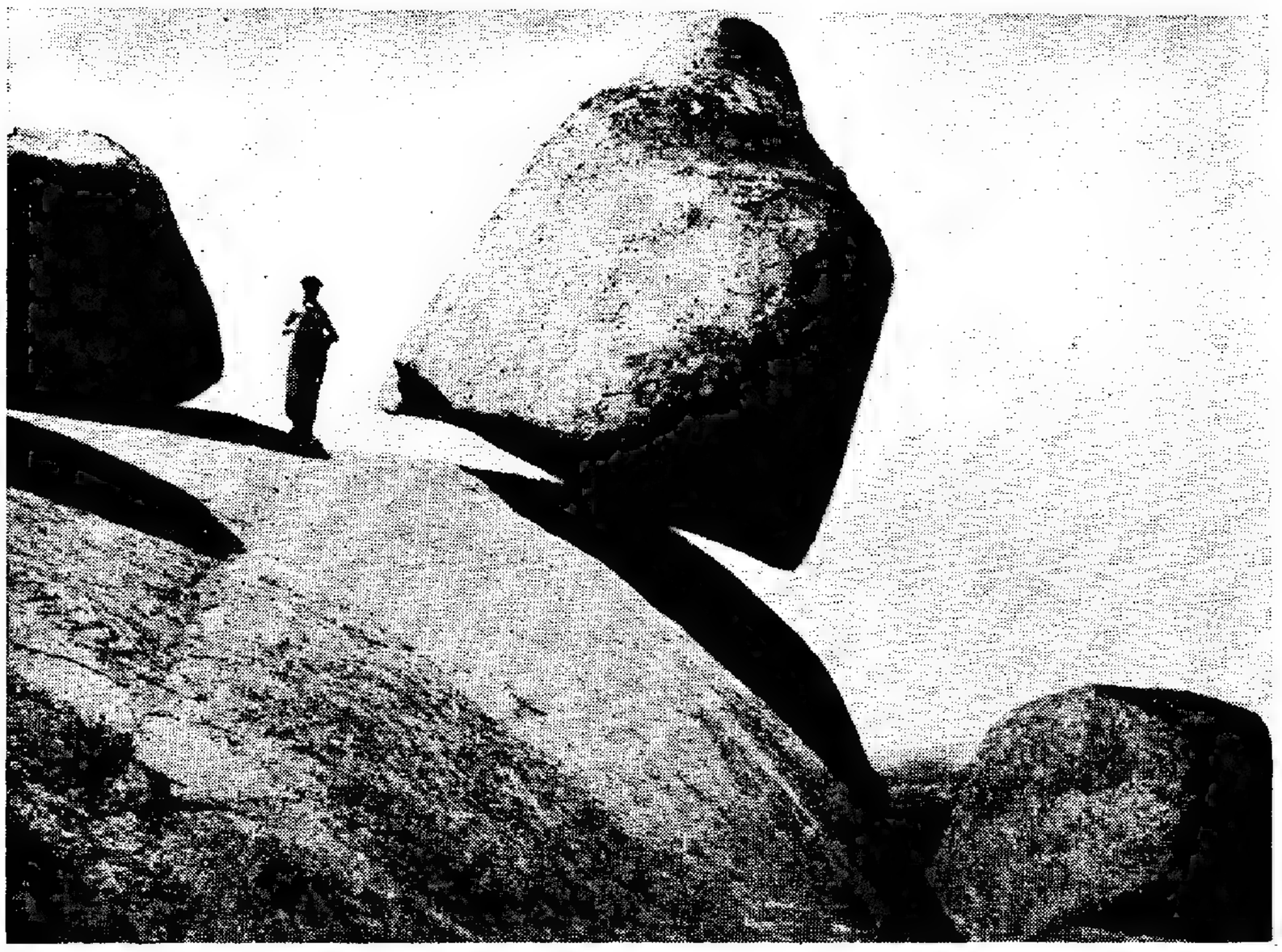
greater than that of the opposite side, and during the ages that the rock has been in its present position it has worn itself a quite secure base.

Often these rocking-stones have been brought to their present positions by glacial action, having been carried miles from their natual situation. In other cases, layers of rock have been rounded by the constant hammering of sea waves. A fine instance of this is pictured in the bay of Rio de Janeiro. The waves, in the course of centuries, separate the top mass from the layer of rock beneath, so that it becomes a "rocking-stone" in some instances, though more often it tumbles from its base and ceases to be remarkable either for position or for shape.

In Southern California, almost at the end of the Sierra Nevada Mountains, explorers have in quite recent years come across a gorge boasting massive cliffs and rocks so carved by wind, rain, and the elements as to present most wonderful likenesses to ancient and modern buildings, and even animals. Furthermore, these cliffs are of the most gorgeous colouring.

So grand and unique are the scenic marvels in this region that the United States Government has been asked to declare the spot national property and so ensure its preservation. There are pillars and columns, plain, fluted and chased; pilasters and colonnades, tiny and titanic, rising tier upon tier, mile after mile, far skyward; arcades, balustrades, corridors; temples, castles, cathedrals, towers,

domes, spires, sphinxes, gargoyles—all perfectly moulded and exquisitely adorned in Nature's silent studio.



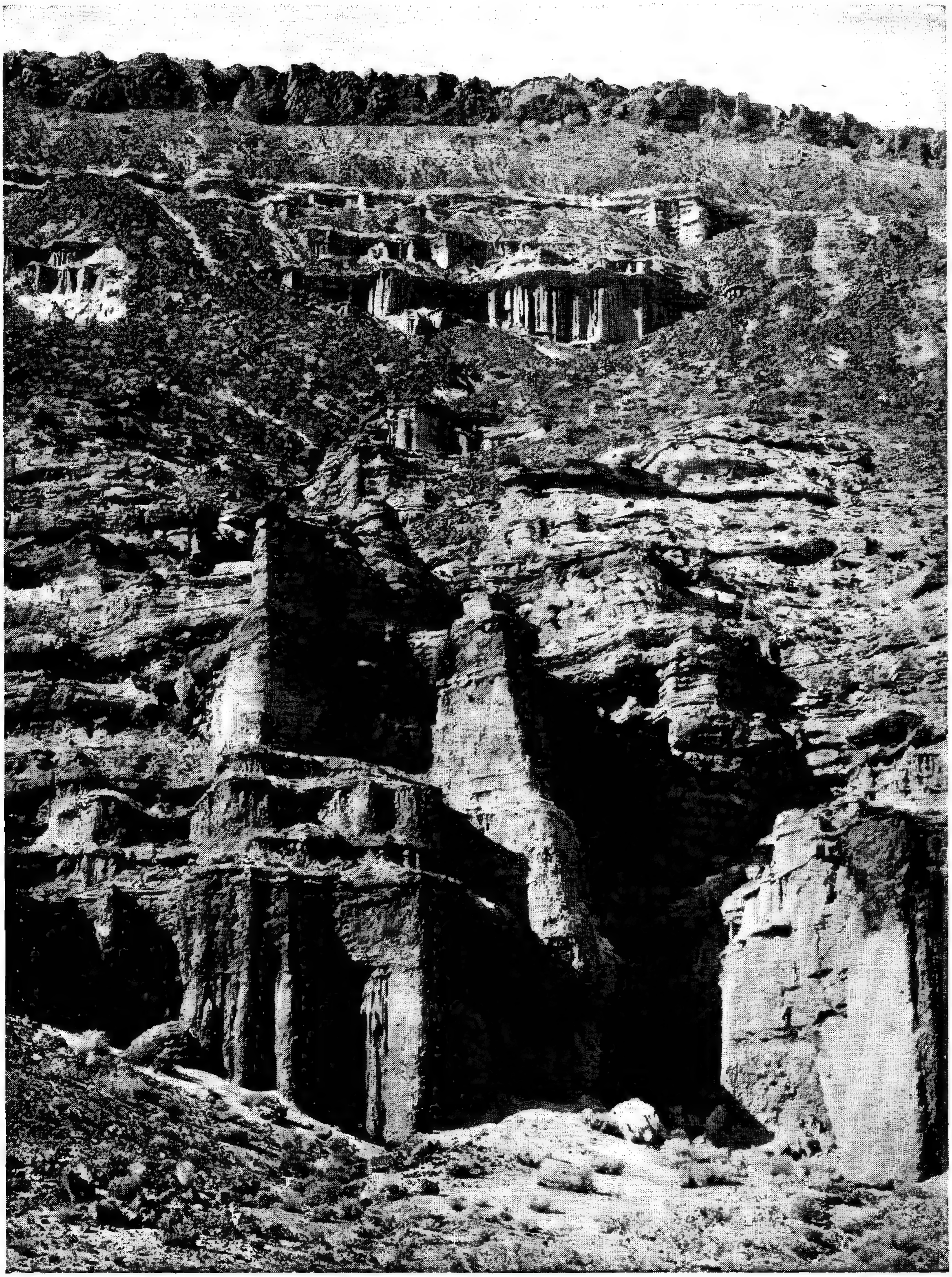
[*Sport & General.*

ROCKING-STONE AT TANDIL, BUENOS AIRES.

On an eminence at the head of the canyon stands what is known as the Temple of the Sun, an impressive grey pile, 125 feet high, approached through a series of terraced entrance-ways, with crumbled walls forming an elliptical enclosure 150 feet in diameter—an ideal amphitheatre. Those who look upon this temple find it difficult to believe that it is not human handiwork. Near by, dominating the region, rises the massive Sentinel Tower, imposing rather than beautiful. Geologists say it has held its commanding bulk aloft for thousands of centuries. The walls are

[*Underwood & Underwood.*

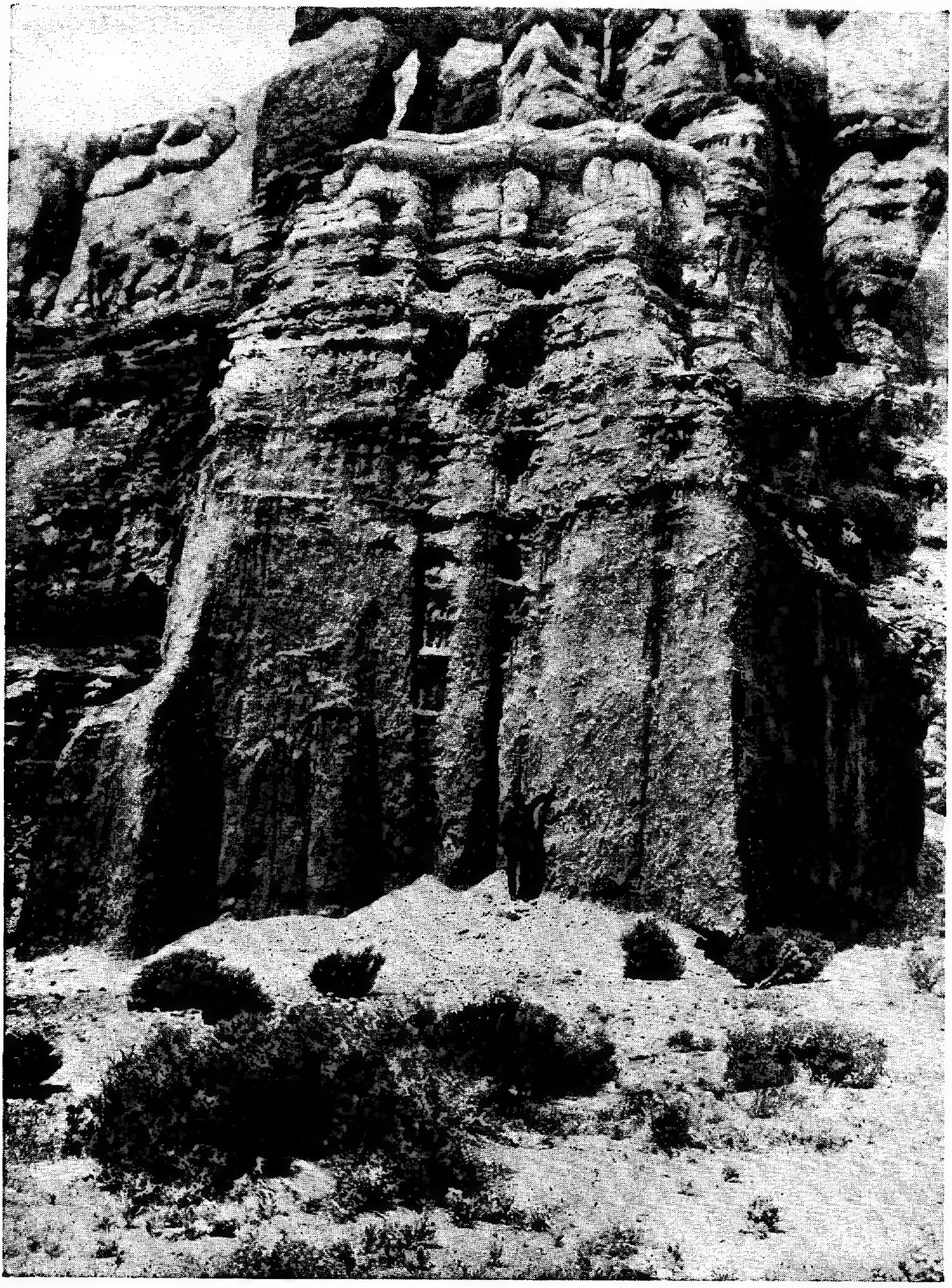
FALLEN ROCKS ROUNDED BY THE SEA,
on the coast, near Rio de Janeiro.



[*John L. Von Blon.*

THE "BURIED CITY," RED ROCK CANYON, SOUTHERN CALIFORNIA.

The sculptural effects in this recently discovered gorge are marvellous, and it is hard to realize that human hands have had no share in shaping them.



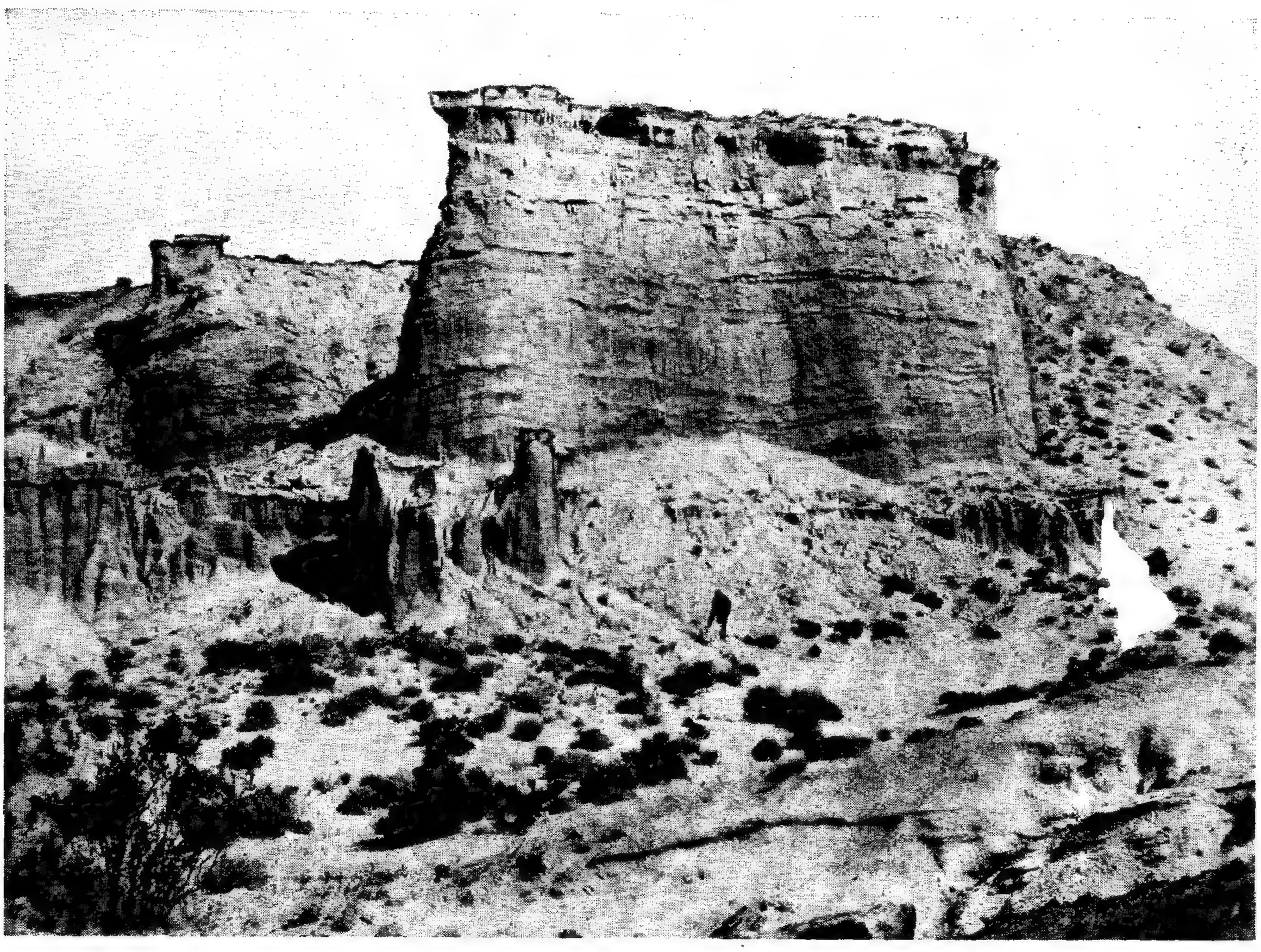
John L. Von Blon.

THE WHITE CHAPEL.

Another realistic piece of sculpture in Red Rock Canyon.

pinkish grey, and the ponderous flinty capstones a brilliant red. A mile away is a colossal pile more than 450 feet high and 1,000 feet long, which has been likened to the Acropolis in Athens, illustrated elsewhere in this book. Seen from any angle, this natural temple is mysterious and awe-compelling, and certain to leave a lasting imprint on the minds of all observers.

Still another masterpiece is the Closed Cathedral, so magnificent



[*John L. Von Blon.*

THE GREAT "TEMPLE OF THE SUN," RED ROCK CANYON, CALIFORNIA.
This grey pile, 125 feet high, is not Man's handiwork but Nature's.

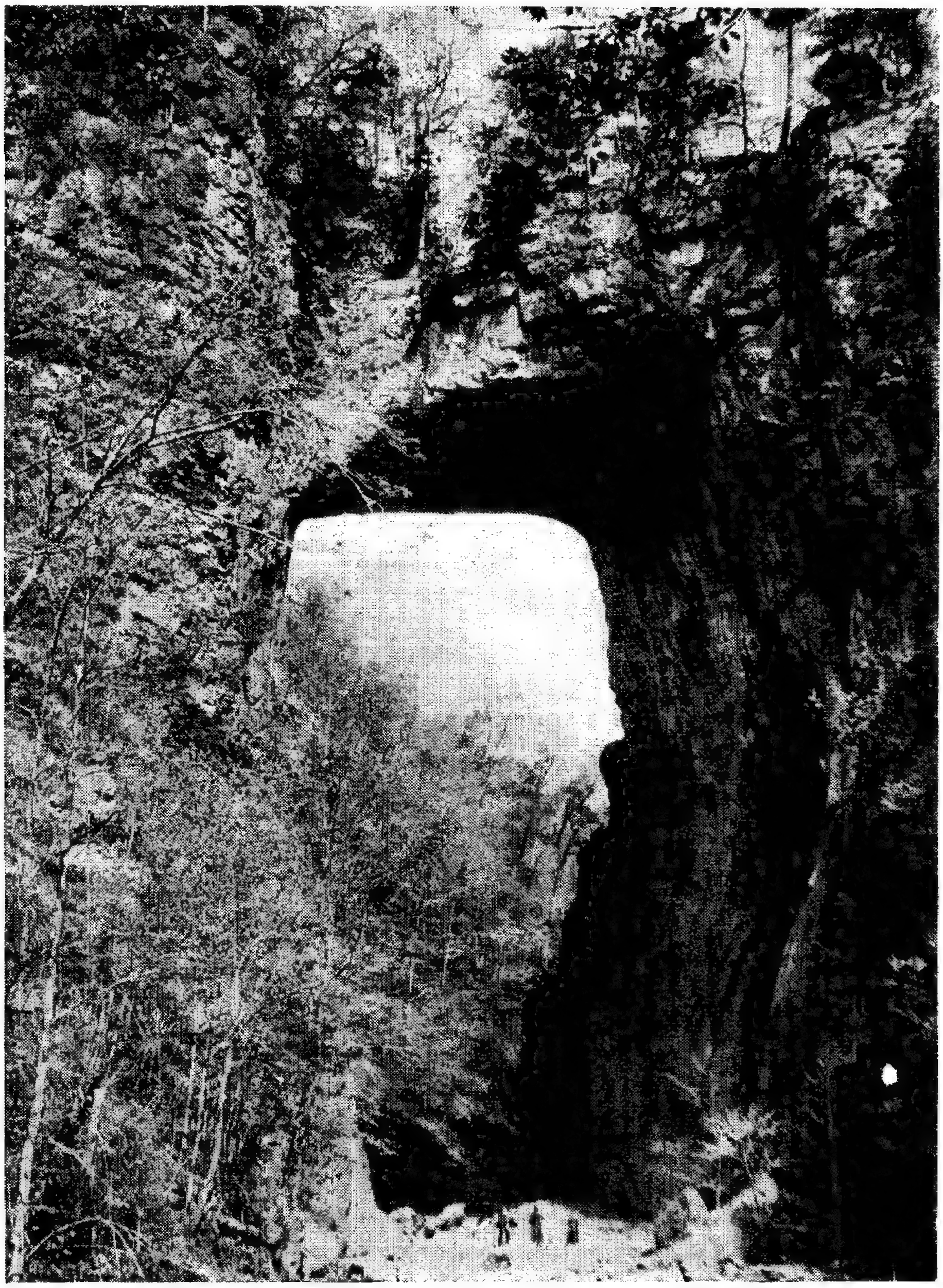
in colouring, so gorgeous, and yet so softly harmonious that no painter could do it justice, and photographs give only a faint impression of its beauty. It is of tremendous size, with an entrance 25 feet high and 15 feet wide, solidly blocked at a depth of 12 feet. Pure white, deep blue, yellow, red, green, and all the intervening shades figure in the decorative scheme, and in places give the suggestion of stained-glass windows. The whole aspect is of antiquity, enhanced by a

Denver and Rio Grande Railroad.

IN THE ROYAL GORGE, GRAND CANYON OF THE ARKANSAS, COLORADO.

The rock walls rise sheer to a height of nearly 3,000 feet. The gorge at its narrowest point is only 30 feet wide, and there is no room for the railway track as well as the river. The line is therefore suspended by means of the "hanging bridge" shown in red.

diagonal crack or fault through the front—evidence of a landslide before the processes of erosion began. The cathedral effect is so realistic that one involuntarily listens for bells to intone the hour or

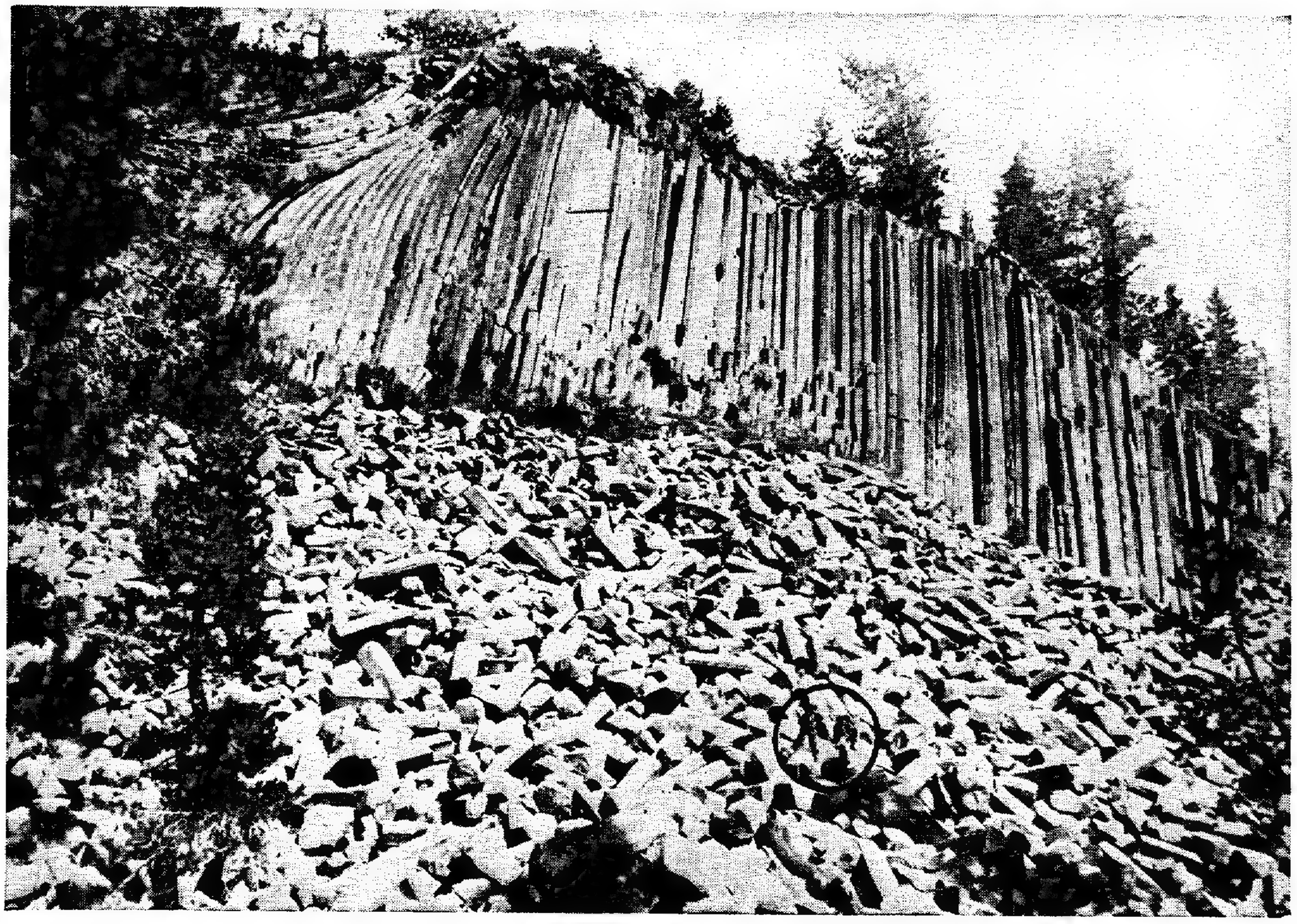


[*Underwood & Underwood.*

THE GREAT NATURAL BRIDGE OF VIRGINIA.

call to prayer. The "Buried City," where masses of burned clay broken up like common bricks have crashed down and crushed and covered some of the best examples of pagodas, is a somewhat melancholy sight, reminding the traveller of Pompeii.

But the world's greatest natural wonder in the way of mighty cliffs is the famous Grand Canyon of the Colorado, of which a glimpse is given in our coloured plate. It varies from five to twelve miles wide, and far, far down in it winds the Colorado River. The walls of the canyon rise to the height of 5,000 to 6,000 feet, and display every variety of curving ridge and ravine, of precipice and rocky gorge. The cliffs are of many colours, and in the glittering sun



[*John L. Von Blon.*

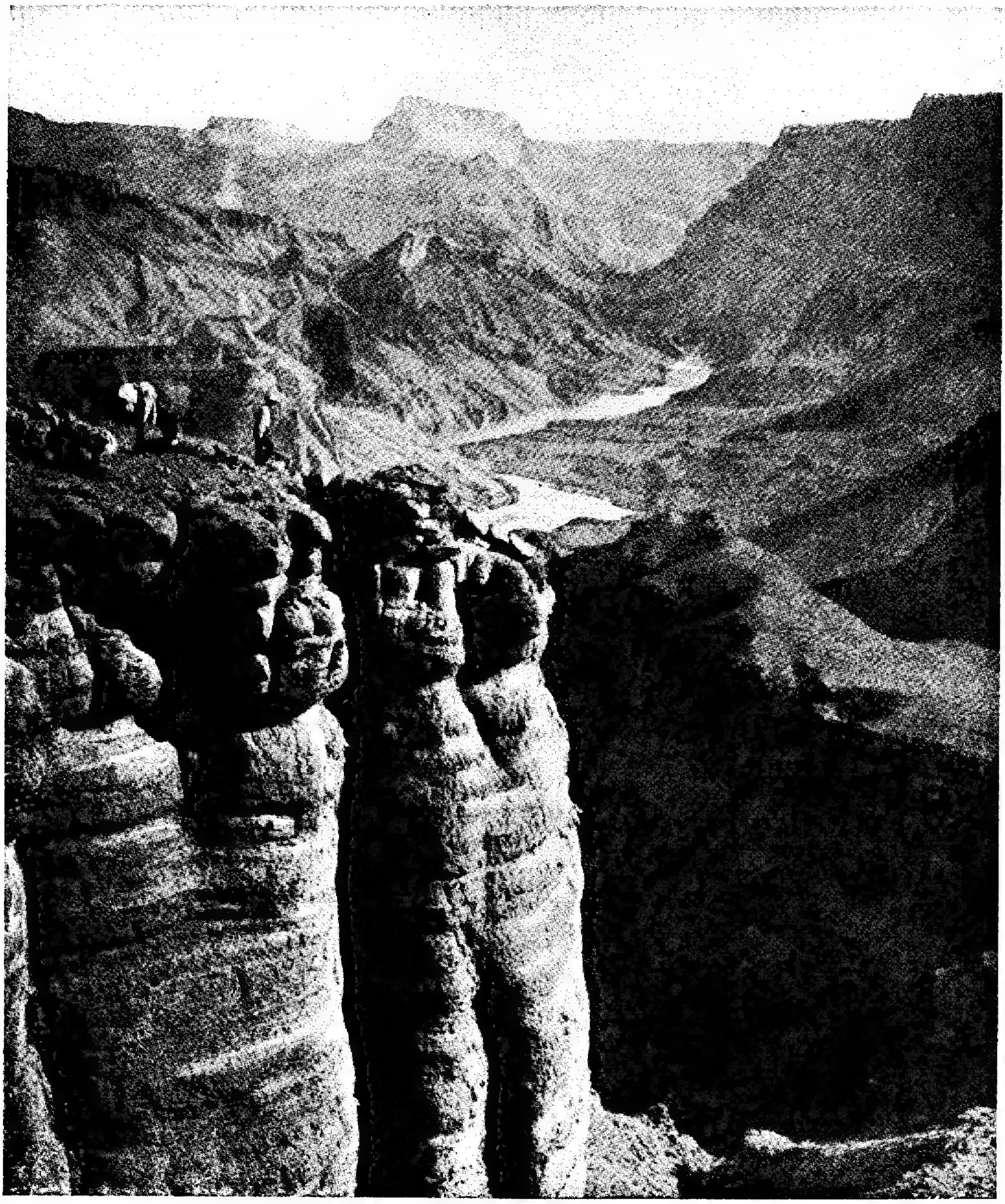
NOT A TIMBER YARD, BUT ONE OF THE WONDER ROCKS OF THE WORLD.

It is known as the Devil's Post Pile, and is in the mountains of Southern California. The columns of basalt tower 60 to 70 feet, while in front of them is a huge pile of broken six-sided columns. The two men in the circle give an idea of the size of the pile.

present a spectacle of awe and grandeur that no one who sees them can ever forget.

In mountainous and glacial districts, this grinding and shaping of rocks is still going on, while wherever the waves of the sea wash against the rock cliffs, Nature is doing bits of carving here and there.

The old saying that "constant dropping will wear away a stone" is always being proved somewhere in the world.

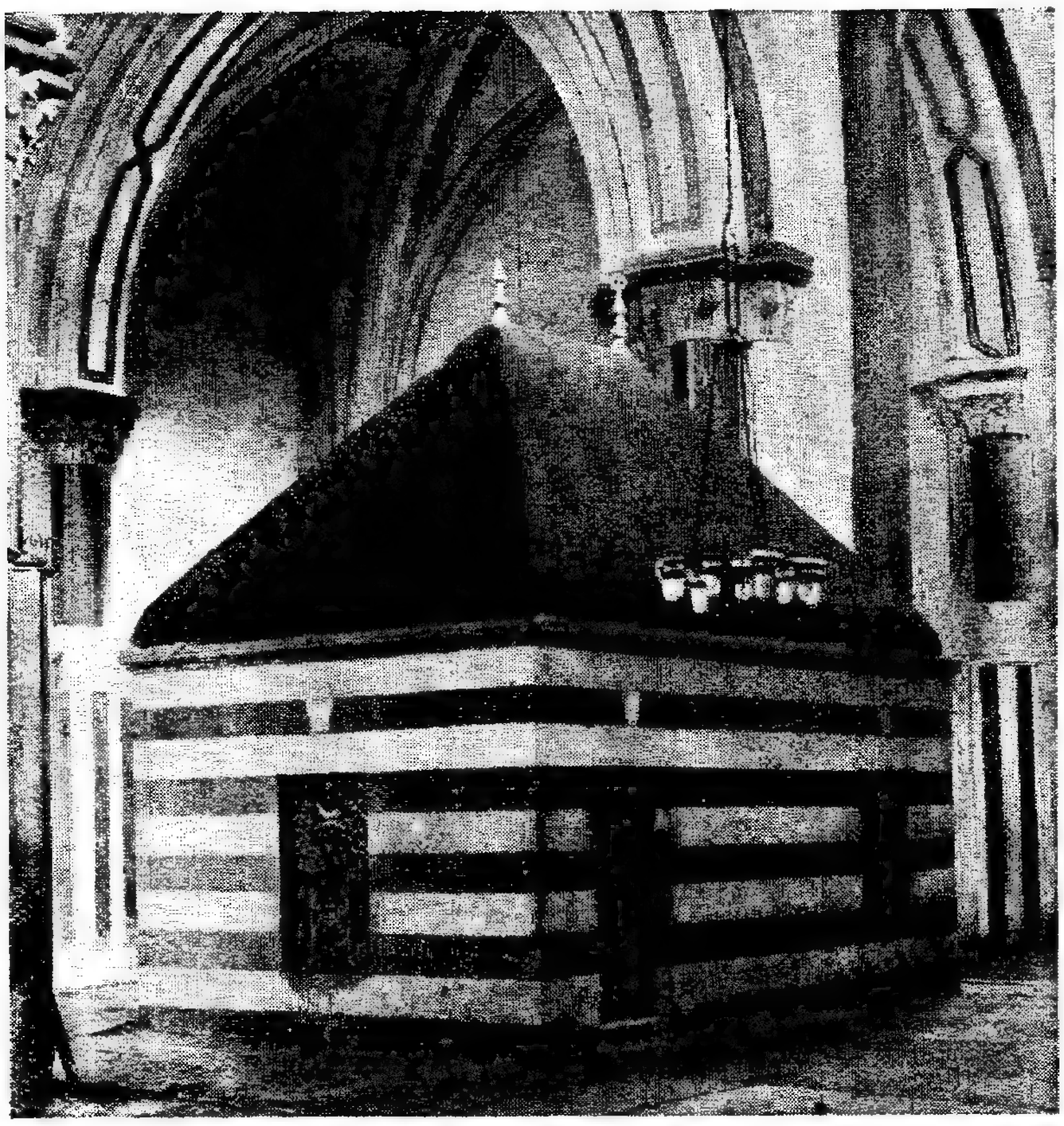


[*E.N.A.*

IN THE GRAND CANYON, ARIZONA.

The Canyon, the largest of the kind in the world, has been cut deep into the rock for 217 miles by the river that winds along its bottom. Its width varies from 4½ to 12 miles, and it would take you half a day at least to get down the steep walls. The Canyon is beautifully coloured, the lower rocks being green; above them are bands of bright red, and nearer the top layers of grey and red rocks.

Two Wonderful Tombs



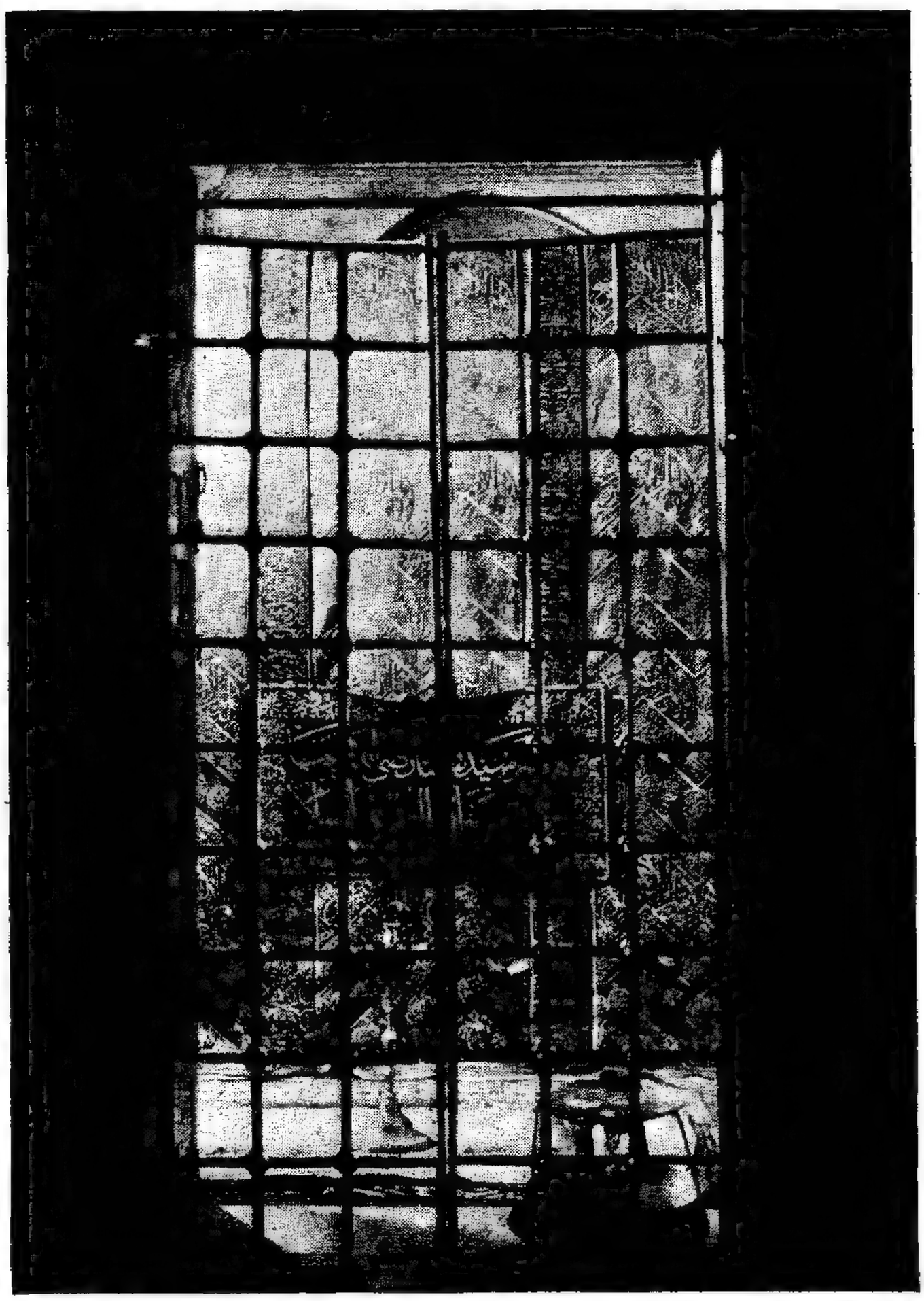
THE TOMB OF ABRAHAM.

EVERY boy and girl has read in the Bible of the Cave of Machpelah, near Hebron, where Abraham and Sarah, Isaac and Rebecca, Jacob and Leah, were laid to rest. This burial ground of the patriarchs is the most historic in the world. The Jews kept it as a holy place throughout the ages; and when the Mohammedans conquered Palestine they in turn preserved the spot as sacred, for the Arabs are equally descendants of Abraham.

The Moslems rightly revere the cave as a holy place, and prior to the War the Christians who had entered it could be counted on the fingers. Only on two occasions have any photographs been taken.

Abraham's tomb consists of a coffin-like structure built up of plastered stone or marble, and covered with three carpets, green embroidered with gold, presented by various Sultans. The shrine of Sarah the photographer was not allowed to enter, being that of a woman. The snapshot he secured shows the tomb as seen through the silver gates.

H. J. S.



[Photographs by the American Colony, Jerusalem.

THE TOMB OF SARAH.

[*Donald McLeish.*

ST. PETER'S, ROME.

The most famous church in Christendom. It covers an area of 240,000 square feet, and is the burial-place of 133 Popes.

Some Wonderful Cathedrals

IN the Middle Ages, when Europe was practically governed from Rome, the Church of which the Pope is head moulded not only the religious life of the nations but ordinary everyday affairs as well. And, since the Church was the most important factor in every department of life, the finest buildings were erected from religious motives and served a religious purpose. The pious poor man, to commemorate an important event in his life, burnt candles at an altar or made some offering to the Church; the rich man built a church or a shrine, and cities erected great cathedrals to mark their prosperity. Thus, all that is best in mediæval art and architecture is centred round the churches and cathedrals of the old towns of Europe, and we see this in Great Britain too. Even the strong castles which remain have churches within them, as is the case with the Tower of London, St. George's Chapel at Windsor, and the church which forms the central and highest

point of Mont St. Michel, in Normandy. These places were built as strongholds, but in nearly every case the finest work and the most beautiful decoration were expended on the church.

Sometimes the design of the Middle Ages was left unfinished for centuries, as at Cologne and Milan. Cologne Cathedral, the finest building in all Germany, was begun in the fourteenth century, on the site of a church built in the ninth century by a famous Archbishop.

[*Donald McLeish.*

MILAN CATHEDRAL.

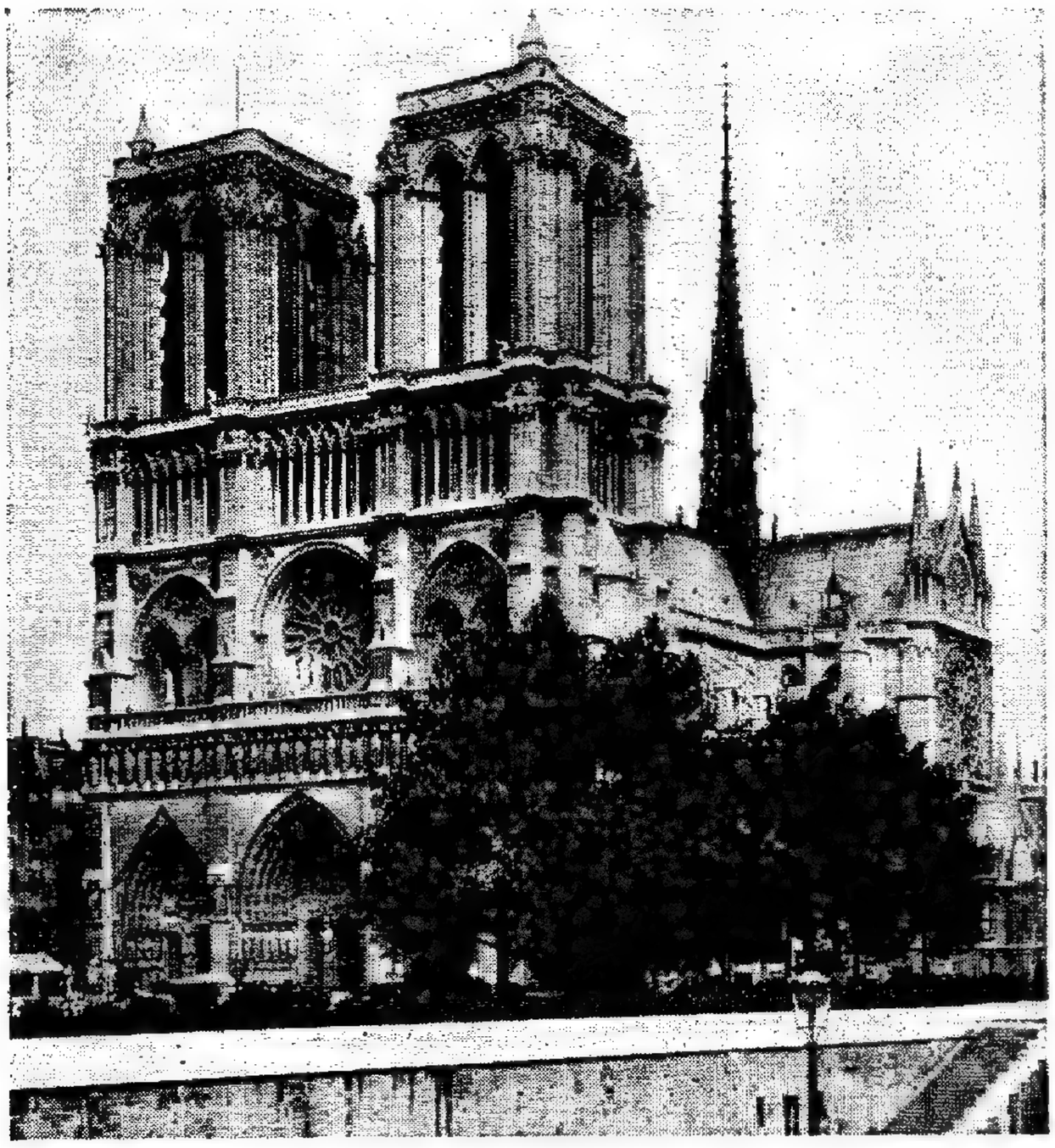
The choir of the present cathedral was finished and consecrated by 1322, but after that the erection of the remainder of the cathedral dragged on until the Reformation was begun by Martin Luther; from then onward, in spite of occasional efforts, the cathedral remained unfinished up to the beginning of last century, by which time the original work had begun to decay. Then all Germany set to work to collect and build, in order to save the greatest piece of architecture of the nation, and in 1880 the cathedral was ultimately finished, while

[*Donald McLeish.*

SPIRES AND STATUES, MILAN CATHEDRAL.

This beautiful building, of marble, is adorned with a hundred spires, a vast number of pinnacles, and over 2,000 statues.

in its tower was hung the " Kaiserglocke," said to be the largest bell in the world that has been hung, though the great bells of Moscow,



[*Underwood & Underwood.*

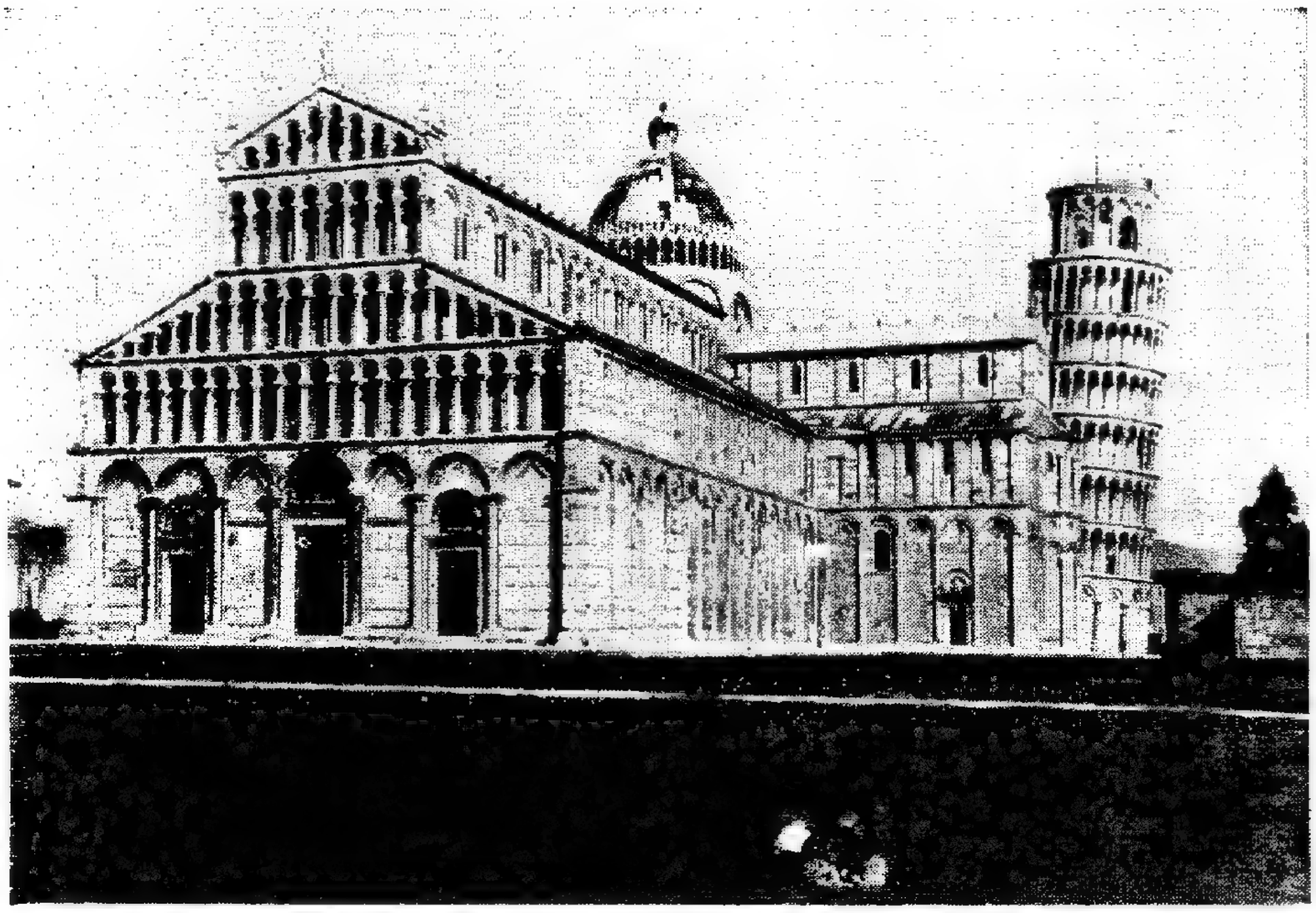
NOTRE DAME CATHEDRAL, PARIS.
One of the most famous churches in the world.

two thousand statues, a vast number of pinnacles, and a hundred spires—and every spire supports the carved figure of a saint. From the main spire there is a splendid view northward over the plains of Lombardy toward the horseshoe-shaped range of the Alps. When the Duke of Milan began the work of building the cathedral, the city was an independent dukedom, a little state making its own laws and having its own army.

Largest and most famous of all the cathedrals of Europe is St. Peter's at Rome. It was originally designed by an architect named Bramante, but the whole design was altered by the famous Michael

too heavy to hang, are far bigger. Among the relics of Cologne Cathedral are three shrines, brought there nearly eight hundred years ago, and said to be those of the Magi, or wise men of the East.

Milan, similarly left unfinished for centuries, is probably the most beautiful ecclesiastical building in Europe, if not in the world. It was begun five and a half centuries ago, and Napoleon ordered it to be finished after his conquest of Italy. It is a fairy palace of marble, decorated with over

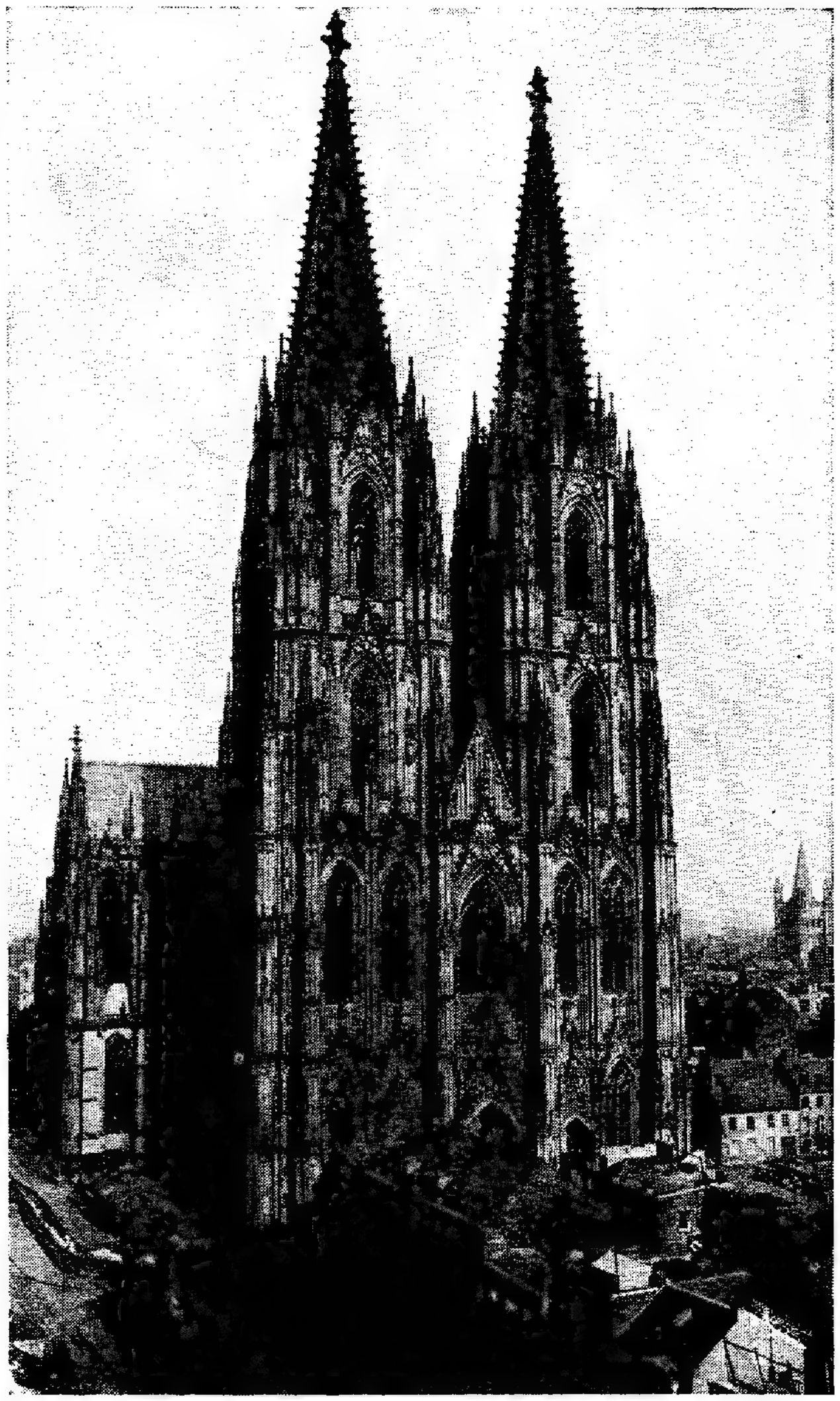


[*Donald McLeish.*

THE CATHEDRAL OF PISA.
This beautiful building, dating from the eleventh and twelfth centuries, is entirely of marble, with white, black and various coloured bands. Beyond is the famous leaning tower.

Angelo, who added the great dome to the original plan. The interior is crowded with mosaics, shrines, tombs, statues, fonts, and paintings, and the great cupola from within is one of the most impressive pieces of decorative architecture in existence.

After the Great Fire of London, Christopher Wren modelled St. Paul's Cathedral on the form of St. Peter's, and its site renders it equally imposing, as one looks eastward towards it. In addition to being the finest English cathedral, it is the resting-place of many famous men, among them Nelson, Wellington, Collingwood, Lord Howe, Earl Roberts, and other military and naval heroes of our history. Wren himself was buried there, as were the painters Reynolds and Opie, with many others who have helped to make English history.



[*Underwood & Underwood.*

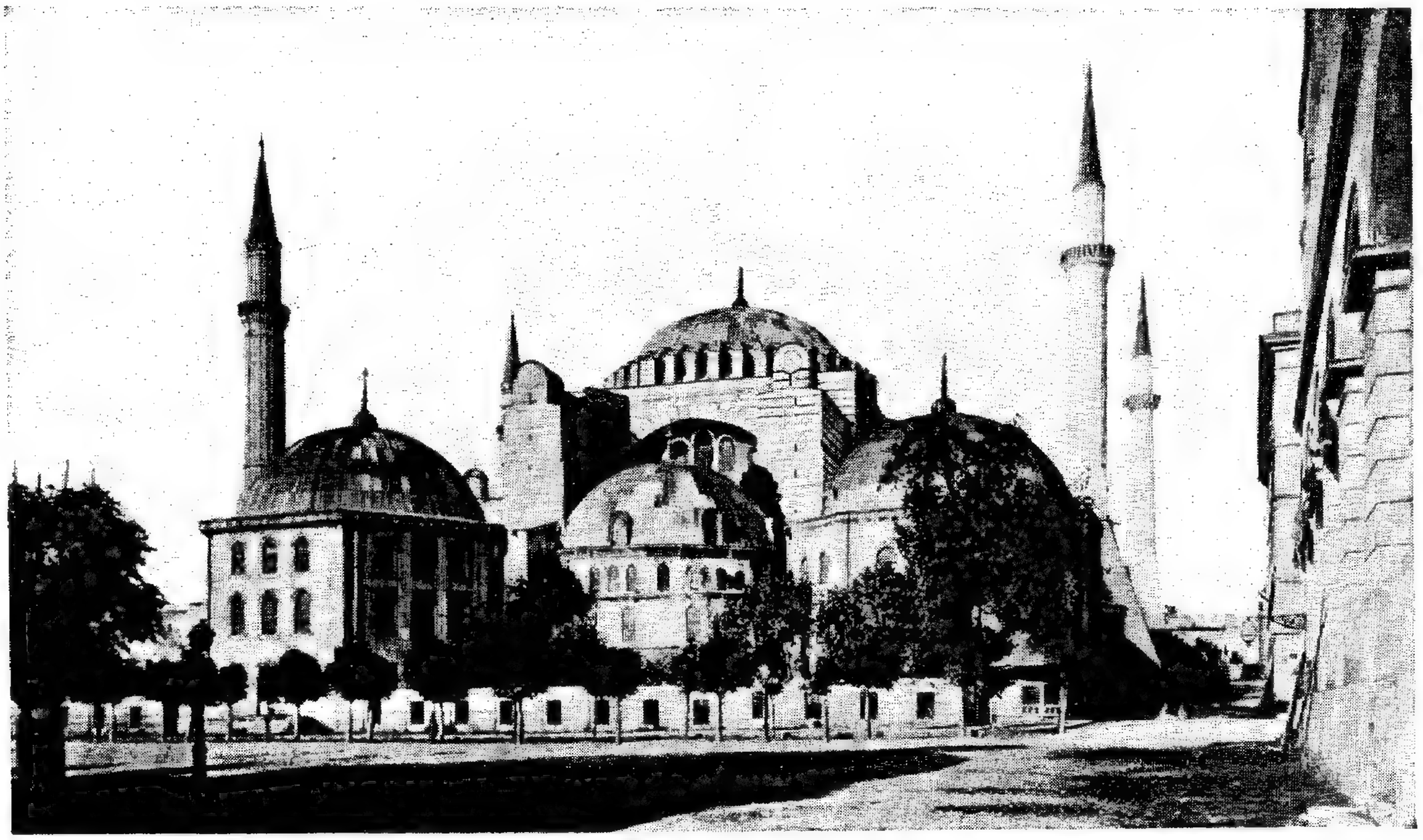
COLOGNE CATHEDRAL.

Begun in the thirteenth century, this Cathedral was not completed until 1880. The spires are 515 feet high, the tallest in the world.

The famous mosque of Aya Sofia, in Constantinople, was once the Christian Church of Saint Sophia, the "Church of the Divine Wisdom," but Constantinople, after one of the great sieges of history, fell to the Turks in 1453. Then the crosses were chiselled off the domes, the mosaic pictures were whitewashed, and minarets were put at the four corners of the building, from which the muezzins might call the faithful to prayer. As late as 1848, while the mosque was being renovated by an Italian craftsman, the then Sultan ordered that all the mosaics should be covered with gold leaf and painted canvas, so that no trace should be left of the

Christian origin of the building. It has been said of Aya Sofia that it is "not only the supreme masterpiece of Byzantine art, but one of the great masterpieces of all time."

Another building of the same type is the Cathedral of St. Mark's at Venice, built in the eleventh century, with its famous campanile, or tower, that fell and was restored a few years ago. The original campanile leaned slightly to one side, but whether by accident or design is not known. Together with the famous bronze horses of St. Mark and the *pala d'oro*, an altar screen of silver, silver gilt, enamel, and precious stones, it is the pride of Venice, and has been so since the



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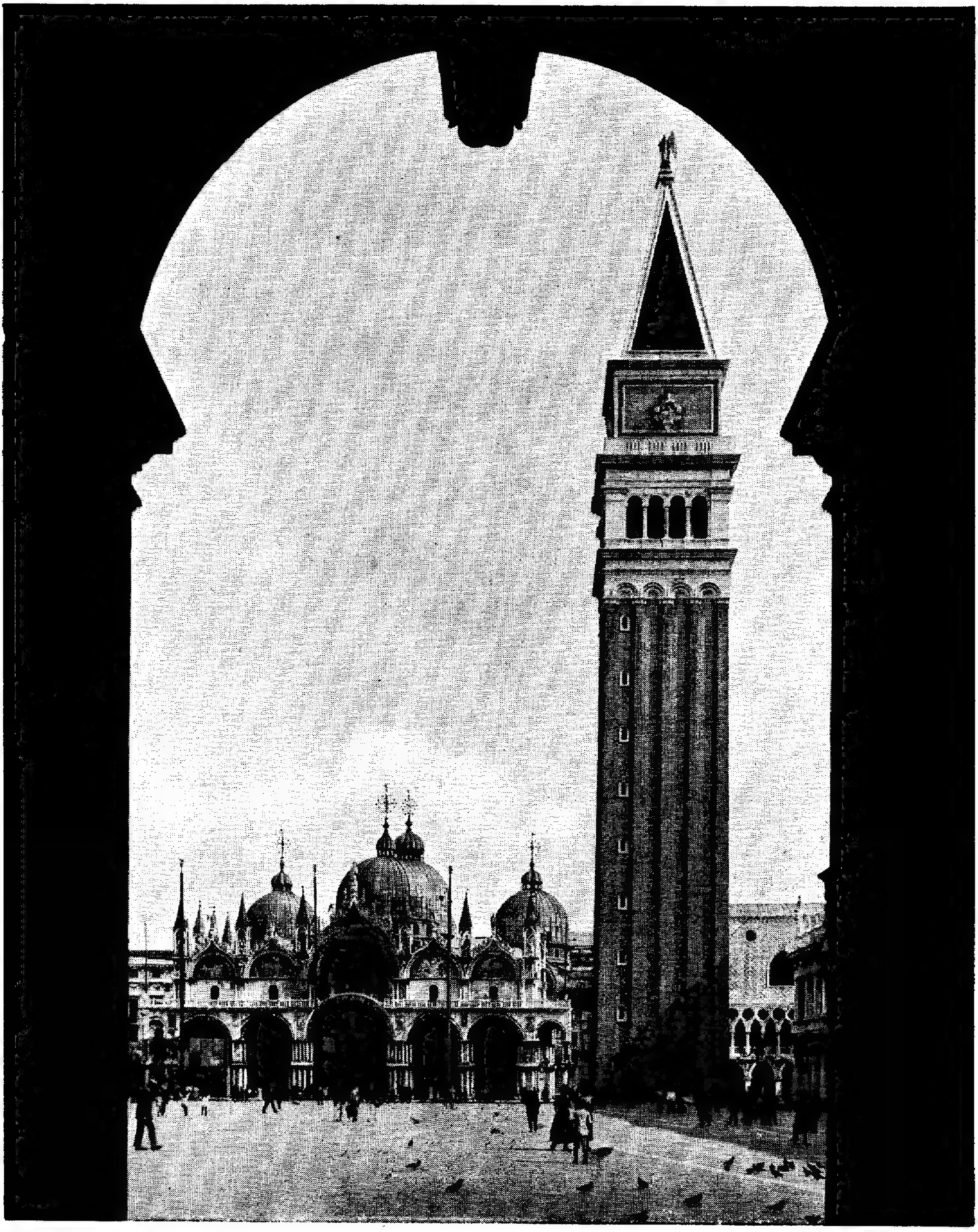
MOSQUE OF AYA SOFIA, CONSTANTINOPLE.

days when Venice was an independent state, ruling the Adriatic coasts and trading with all the world.

One of the most remarkable buildings of Europe is the Leaning Tower of Pisa, which was begun by Bonnenus of Pisa in the twelfth century, carried on by various architects, and finished a century and a half after the laying of the first stone. In its height of nearly 180 feet it leans 14 feet to one side, and there have been long arguments as to whether the foundations sank while the tower was building, or the slant was intentional. The height of each storey is increased on the side to which the tower slants, which some say was an attempt on



[*Donald McLeish.*

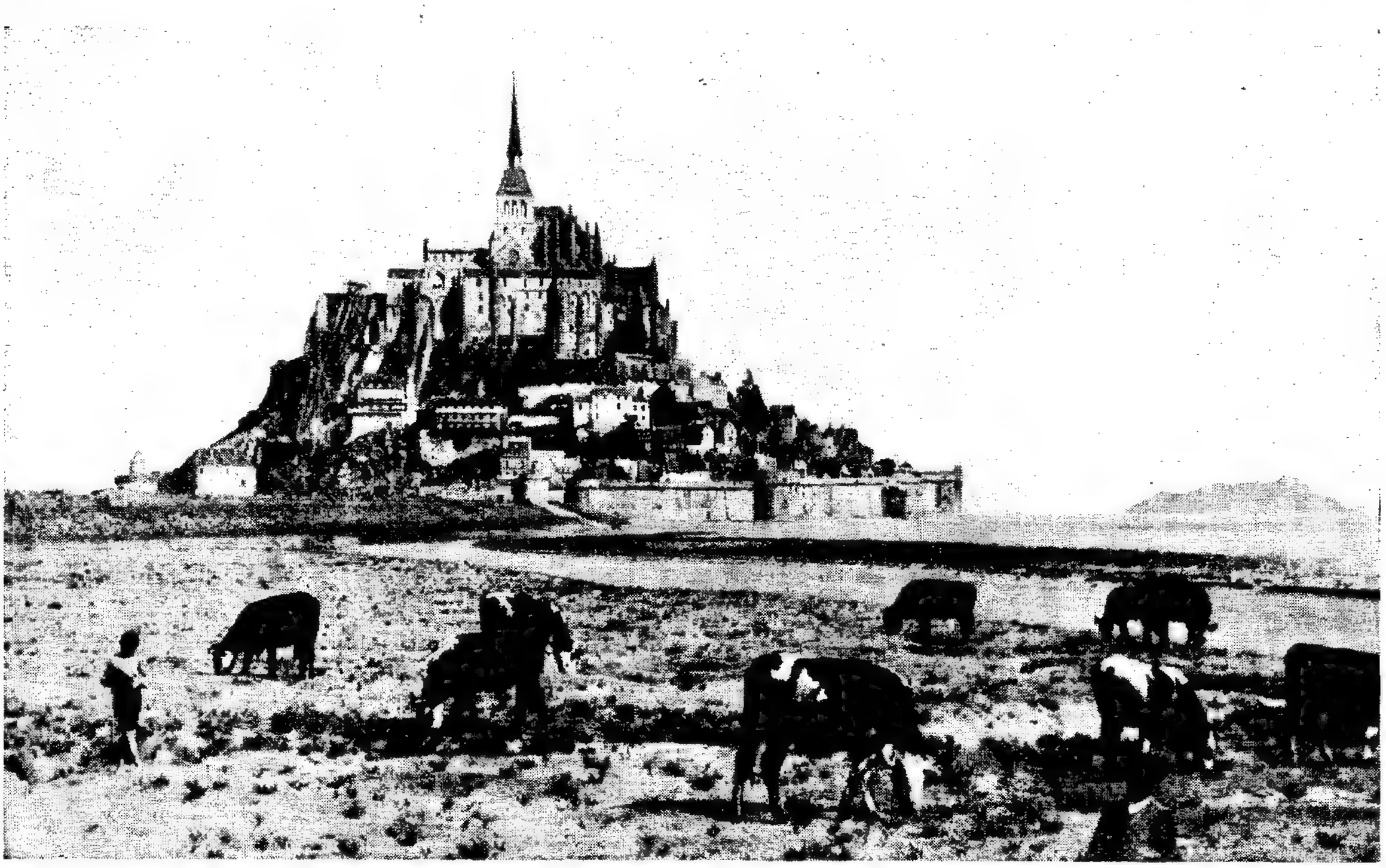
ST. MARK'S, VENICE, AND THE FAMOUS CAMPANILE, OR BELL TOWER.

The Campanile crashed to the ground—fortunately without damaging the Cathedral—a few years ago. It has been rebuilt.

the part of the architects to rectify the sinking, while others say the slant was intentional. It seems certain now, however, that the foundations were insecure from the first. In the cathedral to which the tower belongs is a great bronze lamp, which it is said Galileo studied as it swung, thereby forming his theories regarding the uses of the pendulum and the movements of the planets. In the tower itself, three hundred steps lead to the top, giving a magnificent view of the Carrara Mountains, of the city of Pisa, and of the blue sea beyond. Pisa, in the days when the cities of Italy were little independent states, was a place of great power, rivalling even Venice and Genoa.

In Great Britain, too, we have stately and beautiful cathedrals which men come from the ends of the earth to see. Canterbury, York, Lichfield, Salisbury, Wells, and many others could be mentioned, but as they are more or less familiar they are not pictured here. Whenever you are on holiday near a great cathedral, make a point of seeing it, for whether you know anything of architecture or not, you will be impressed and instructed, and you will think with love and reverence of those fathers of ours who built these mighty fanes and worshipped in them.

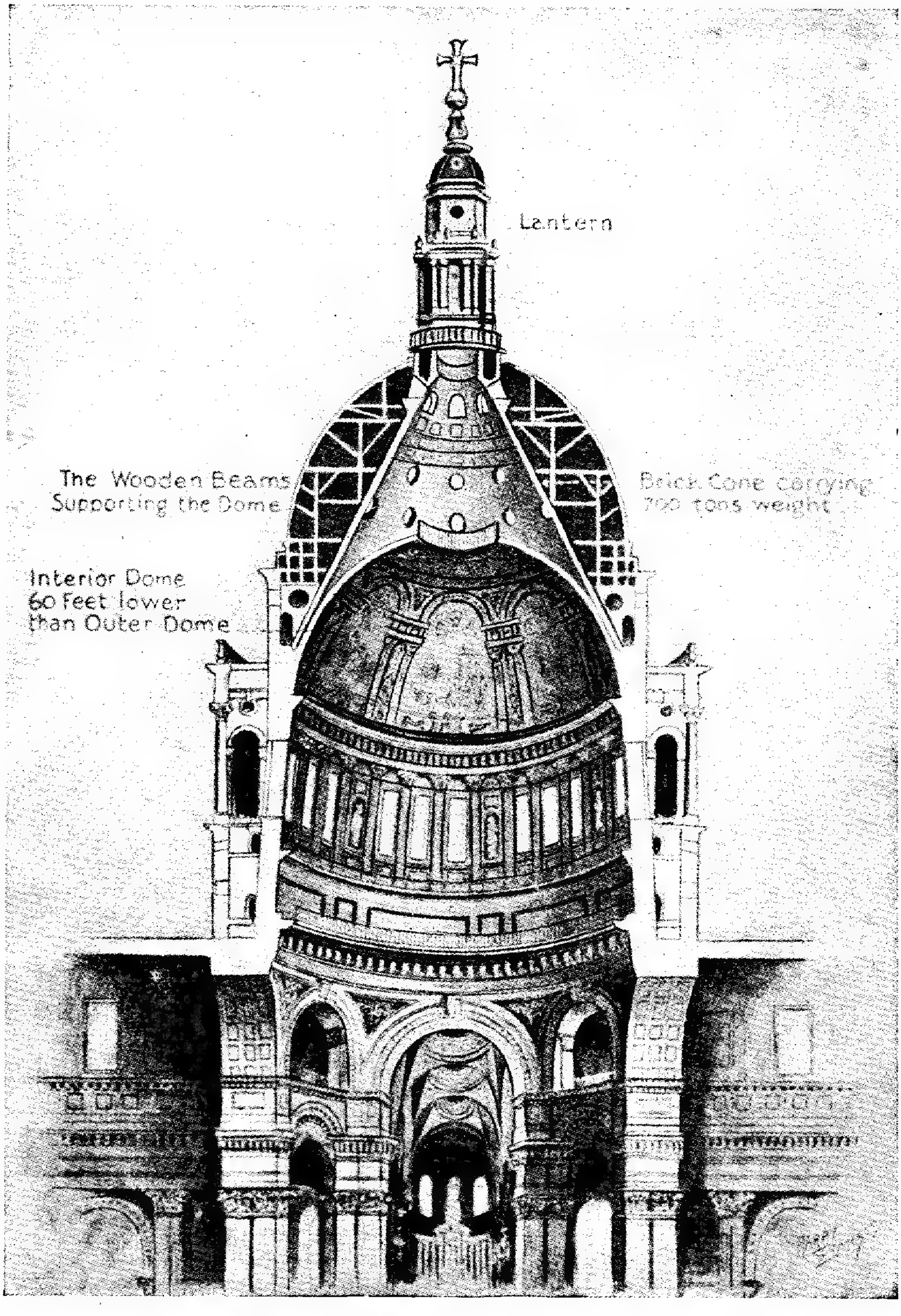
E. C. V.



[Underwood & Underwood.

MONT ST. MICHEL.

Generally known as "la Merveille" (the marvel), this is one of the most beautiful and romantic buildings in France. "Mont St. Michel," said Victor Hugo, "is to France what the Great Pyramid is to Egypt. It should be preserved at any cost—this double work of Nature and Art."



INSIDE THE DOME OF ST. PAUL'S CATHEDRAL.

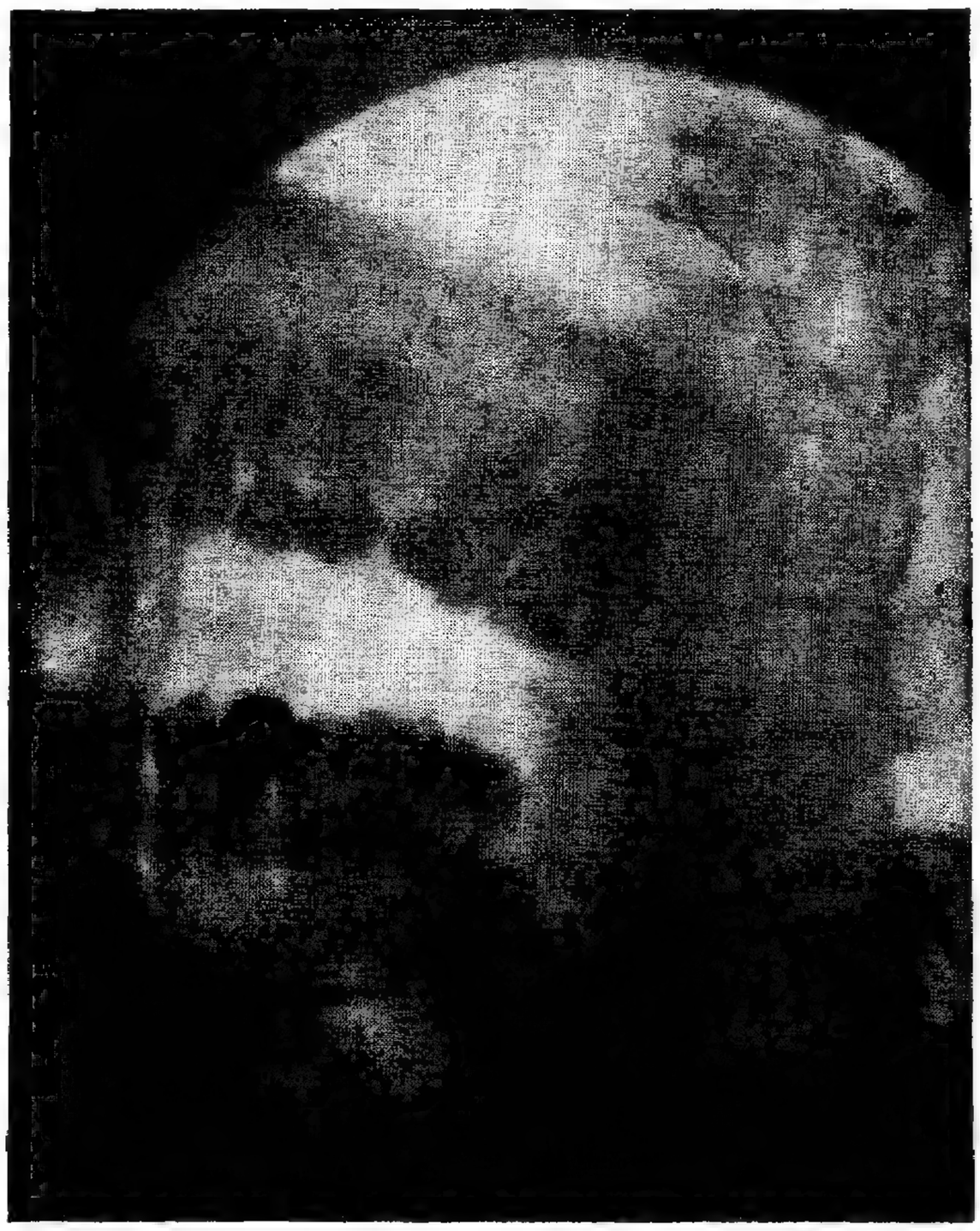
Comparatively few people realize that the dome seen from the street is only a dummy, or outer shell, of wood covered with lead. The brick cone within really carries the weight of the lantern (over 700 tons) and the ball and cross. The inner dome to which one looks up in the Cathedral is 60 feet lower than the outer dome. The height from the pavement to the top of the cross is 365 feet, or as many as there are days in the year.

X-Rays

WHAT are they? We cannot say in few words, or indeed at all with certainty, but at least we know how they can be produced. Air is practically a non-conductor of electricity, but if the pressure of an electric current is great enough it will leap through the air; the air, however, resists its passage, so that the electricity appears as a spark, or in the case of lightning as a long streak. Suppose we take a glass tube and connect a metal plate to each end of it with wires leading to an electrical apparatus giving a current of very high pressure. We will assume that the tube is so long that electricity cannot pass through the air in it. If we now seal the tube and pump out most of the air, electricity would be able

AN X-RAY PHOTOGRAPH
showing shrapnel bullet embedded in skull. The wire shows the point of entrance.

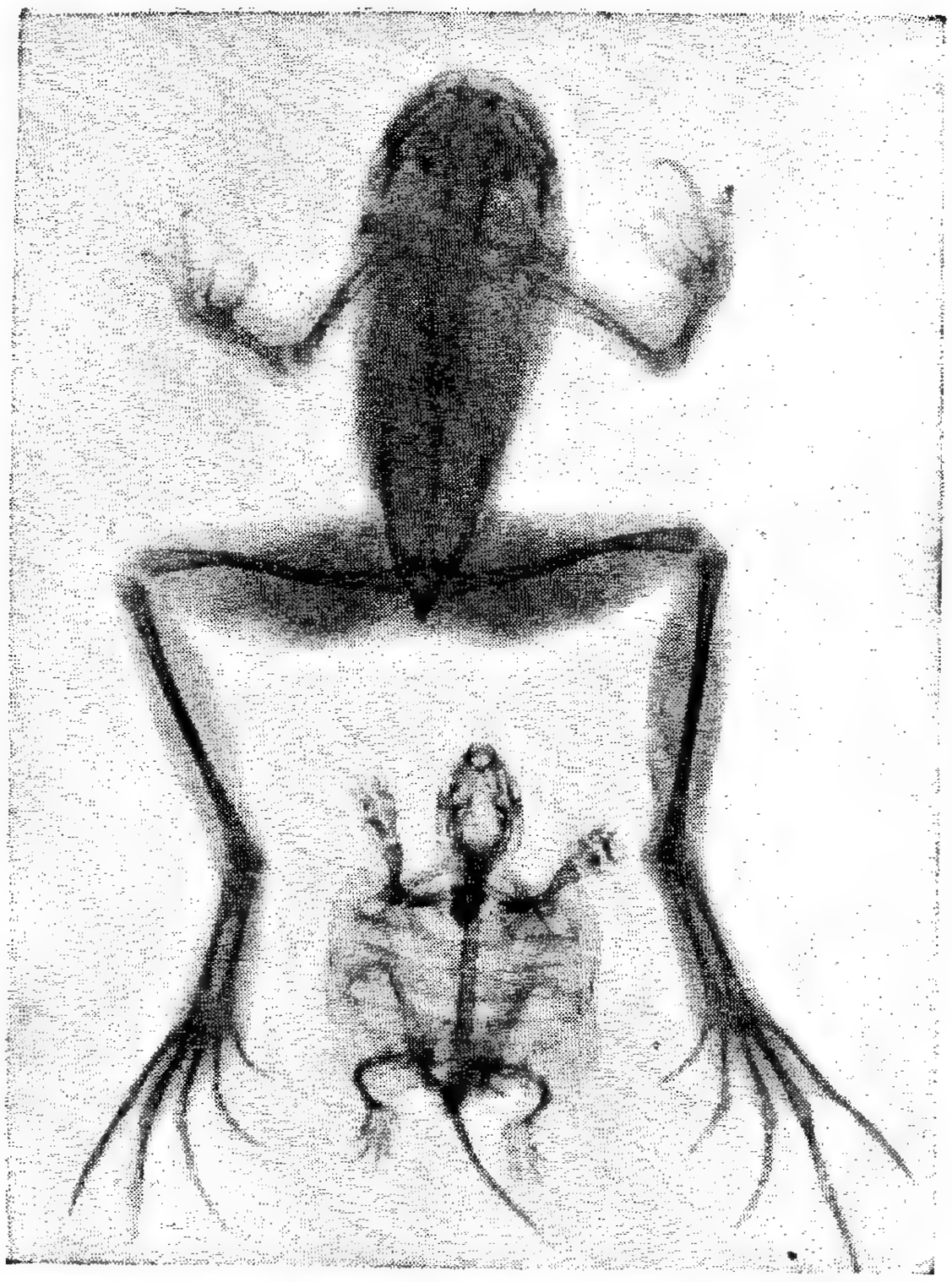
to pass, but instead of a spark there would be a luminous shaft of light. Rather more than a quarter of a century ago, Professor Röntgen was experimenting with a glass tube from which nearly all the air had been pumped out. There was a small plate in the tube, attached to the end of one of the wires, and another plate near the middle. The tube itself was covered with a piece of black cardboard. On looking round Professor Röntgen noticed that a chemically prepared screen several feet away was lighted up! What



Photopress.
AN X-RAY PHOTOGRAPH OF A MAN'S JAW,
showing teeth and a gold filling.

had happened was that when the electric current struck the end plate certain rays were thrown back on to the centre plate, and from the centre plate other mysterious invisible rays, till then unknown, were projected right through the glass tube and through the black cardboard on to the chemical screen. These were X-rays or, as they are still sometimes called, Röntgen rays.

It was then found that not only would X-rays pass through glass and black cardboard but through most other solid substances as well. They will not light up the solid substances themselves but, after passing through them, they light up a chemically prepared screen, so that on placing one's hand, for instance, in the path of the invisible rays a shadow of it is cast on the screen. The fleshy part of the hand appears as a light shadow and the bones as darker shadows. When these shadows are photographed, the photographs are called X-radiographs. The rays do not, so far as we know, pass through thick lead; consequently a lead bullet embedded in a man's flesh or bone appears black in the X-radiograph, and the surgeon knows exactly where to get at it. One of our illustrations shows a bullet embedded in a soldier's skull—the piece of wire indicates where it entered.



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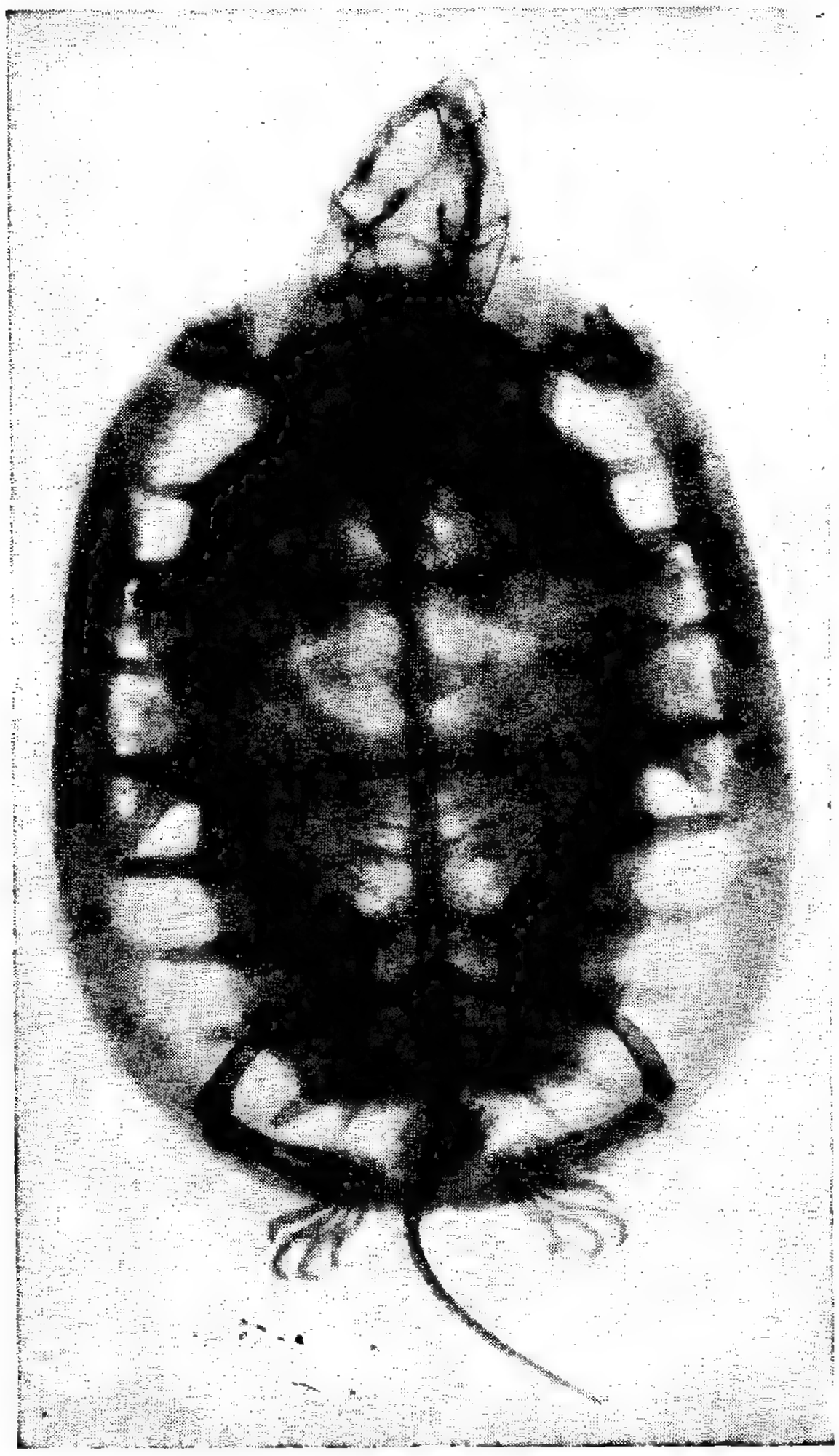
X-RAY PHOTOGRAPHS OF A FROG AND A TADPOLE.

X-rays are used not only by medical men but in many other professions and trades. The rays will penetrate an inch of solid steel and show up blow holes or other defects inside an iron bar that has been welded. They will pass through a twelve-inch thickness of wood and show up any cracks or knots inside it that cannot be seen from outside, enabling aeroplane manufacturers to make sure that none but perfectly sound timber is used in their machines.

By means of X-rays we are enabled to photograph many other things which, without them, would be invisible, such as a pair of

spectacles in a leather case or cigars in a box. Artificial gems can be distinguished from real ones. The bones of one's foot can be seen without taking the boot off. A letter can be photographed and read without breaking the seal of the envelope. Consumption—that terrible disease of the lungs—can be detected, and an internal injury can be examined before an operation. Injuries and diseases of the bones are easily seen. Marbles or coins swallowed by children can be located with ease, indicating whether operations should be performed and how best to perform them. In fact, many of the wonderful cures effected by modern surgery would be impossible without the assistance of X-rays. And as our photographs show, the rays add greatly to our knowledge of the structure of birds and animals.



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AN X-RAY PHOTOGRAPH OF A TURTLE.

The shell, it will be seen, presents no obstacle to the passage of X-rays.

After X-rays were discovered, it was not realized for some time that great care is necessary in using them, as they are very dangerous to experiment with. Several of the pioneers in X-ray work lost their hands and arms, and even their lives, owing to the serious and injurious results of exposing themselves too freely to the influence of the rays. Fortunately workers in this branch of science are nowadays protected against such ill effects and, unless from carelessness in handling apparatus, there is little danger.

P. J. RISDON.

Wonderful Waterfalls

ALTHOUGH Niagara ranks as one of the greatest of the world's waterfalls, and is the best known, it is by no means the highest. The level of water in Lake Erie, just above the falls, is 570 feet; in Lake Ontario, just below the falls, it is 245 feet, so that, when the descent of the Niagara river is allowed for, the falls themselves are only about 300 feet in height. It is the vast volume of water that pours over, and the wonderful effects produced, that make Niagara so famous. Illuminated at night, the falls present a marvellous spectacle, while in winter, when frost transforms the rushing water into fairy palaces of ice, Niagara is a picture of beauty, as some of our photographs show.

Two waterfalls compete for the honour of being the highest in the world: these are the Sutherland Falls, in South Island, New Zealand,

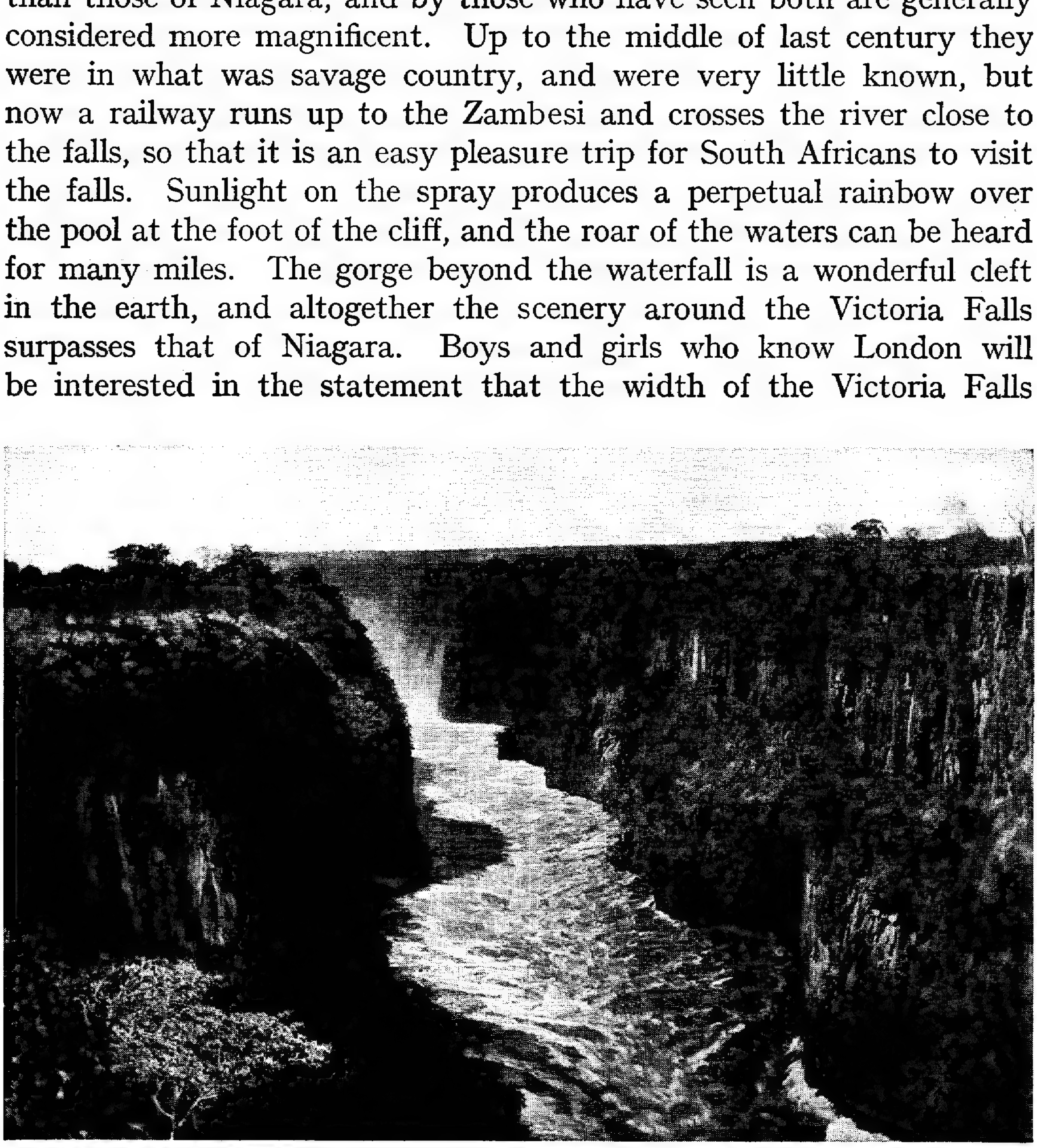
[*Sport & General.*

TOURISTS AT THE FOOT OF THE NIAGARA FALLS

The energy of the falling water is used to generate electricity which lights cities scores of miles away and supplies power to their factories and trams.

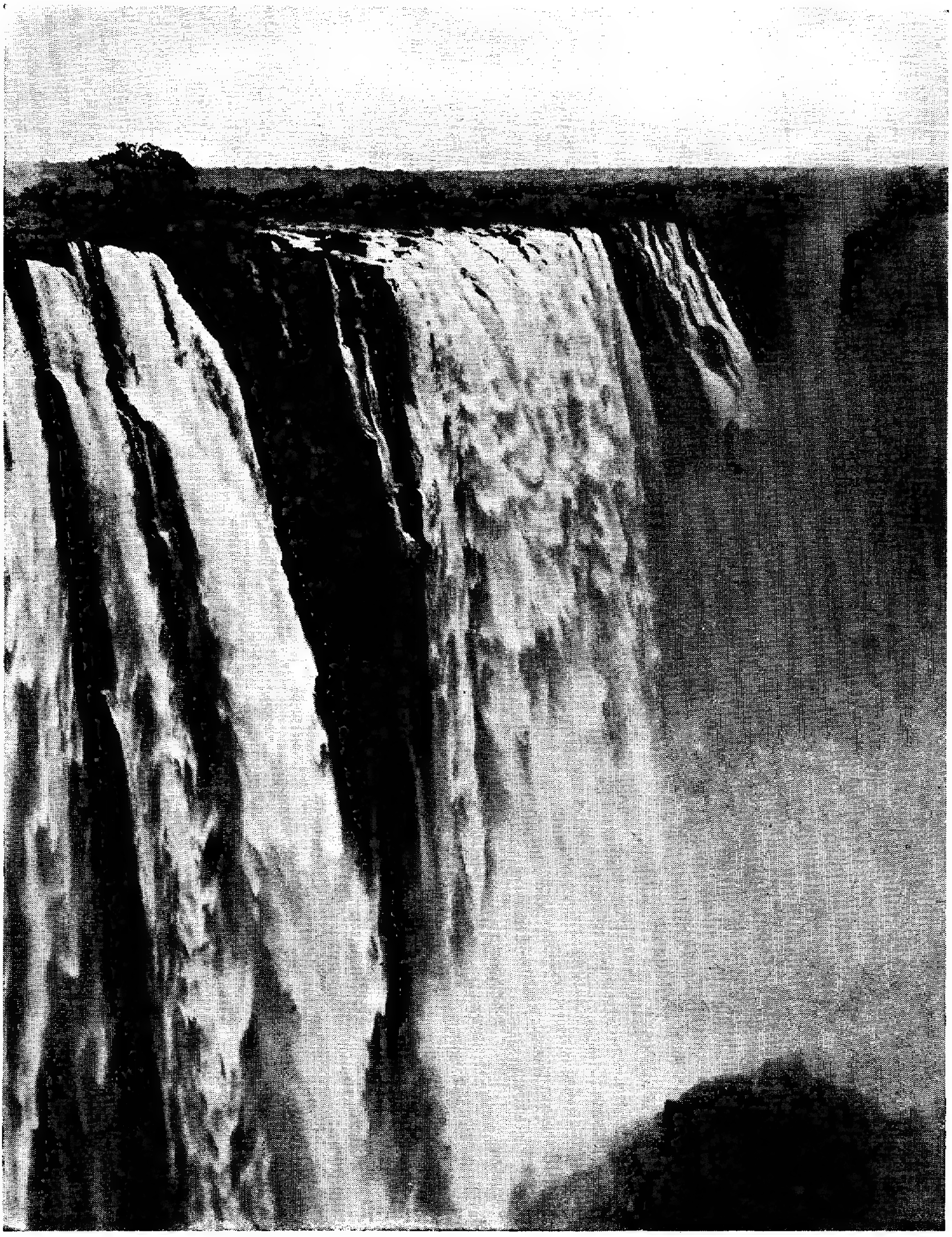
and the great falls of Kaieteur, away in the wilds of British Guiana. Kaieteur has a single continuous fall of 750 feet; but it is away in the Guiana highlands, and until recently had only been visited by exploring parties, though it is now better known, through the large model shown at the British Empire Exhibition. Both the Kaieteur and the Sutherland Falls are more conspicuous for their height than for the amount of water which flows over them; they have not the majesty of Niagara or the Victoria Falls.

The Victoria Falls on the Zambesi River, in Rhodesia, are higher than those of Niagara, and by those who have seen both are generally considered more magnificent. Up to the middle of last century they were in what was savage country, and were very little known, but now a railway runs up to the Zambesi and crosses the river close to the falls, so that it is an easy pleasure trip for South Africans to visit the falls. Sunlight on the spray produces a perpetual rainbow over the pool at the foot of the cliff, and the roar of the waters can be heard for many miles. The gorge beyond the waterfall is a wonderful cleft in the earth, and altogether the scenery around the Victoria Falls surpasses that of Niagara. Boys and girls who know London will be interested in the statement that the width of the Victoria Falls



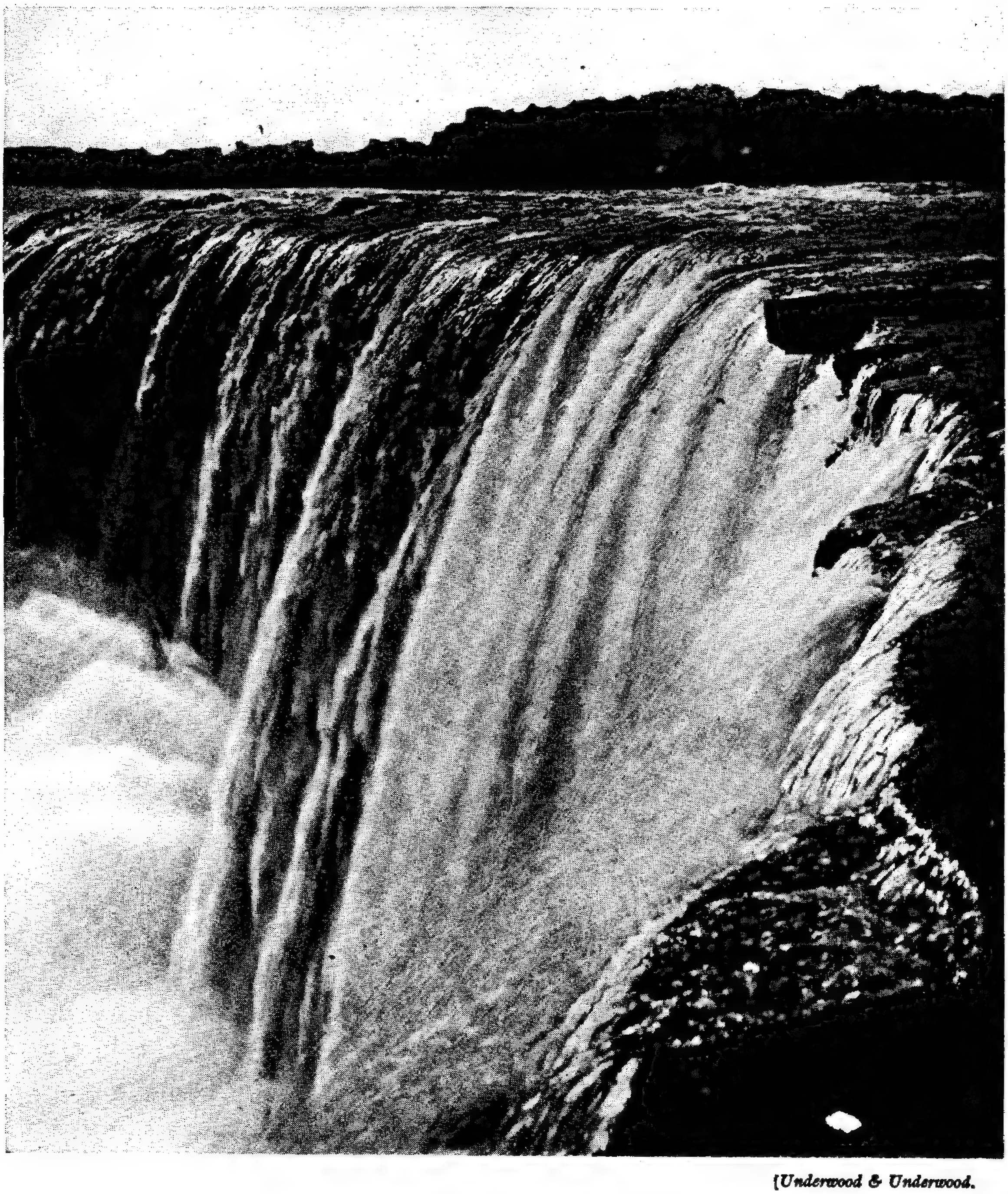
[By courtesy of the British South Africa Co.

BELOW THE VICTORIA FALLS, RHODESIA.



[*By courtesy of the British South Africd Co.*

THE VICTORIA FALLS.

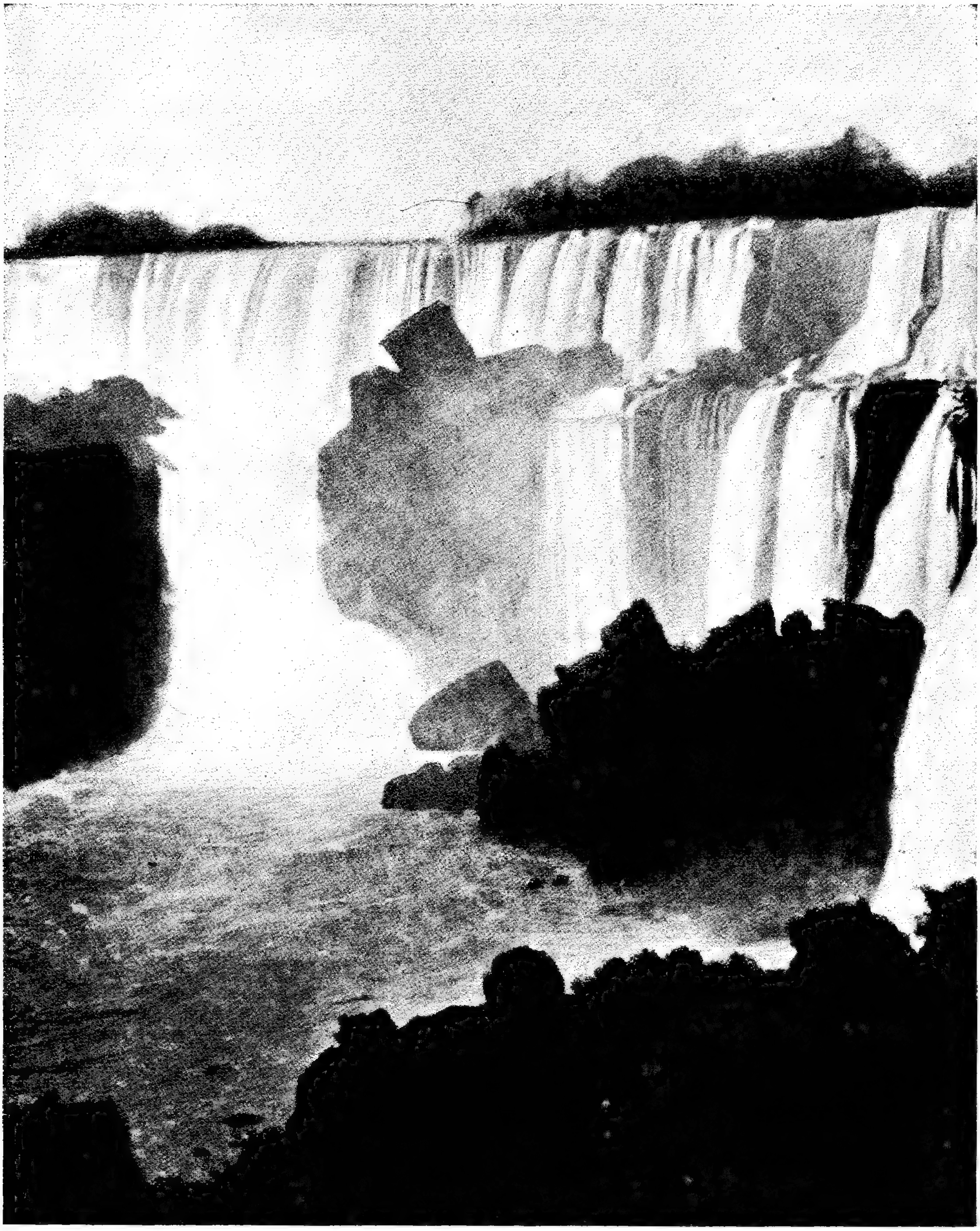


{*Underwood & Underwood.*

NIAGARA: THE HORSESHOE FALLS.

is almost exactly the distance between the Marble Arch and Oxford Circus.

A more magnificent waterfall than either Niagara or Victoria is hidden away in the heart of South America. More than two centuries ago, when the Jesuit missions of Paraguay were formed in the Guarani Indian territory, legends were brought to the mission stations of a



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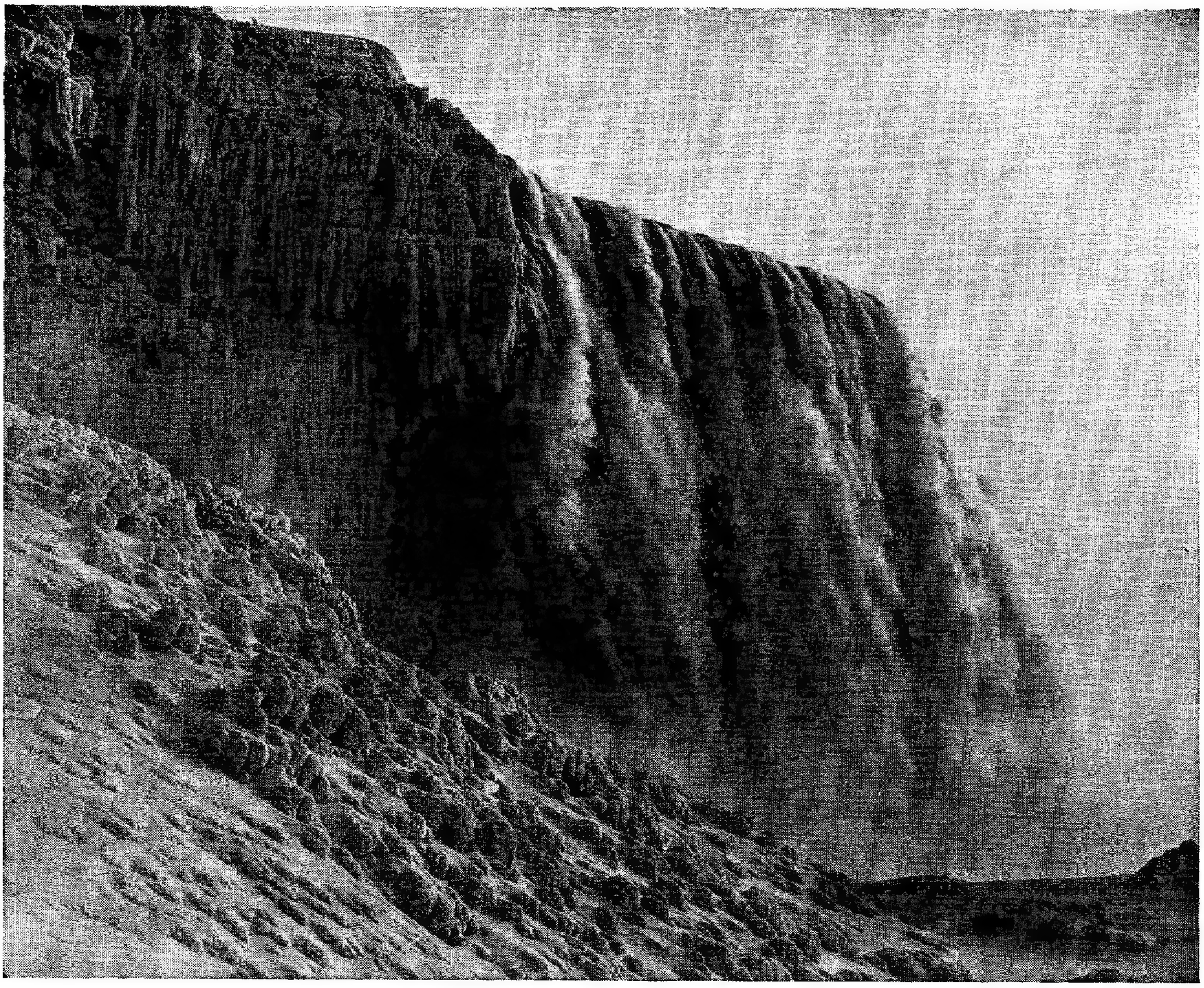
THE IGUASSU FALLS.

These wonderful and little-known falls, situated partly in Brazil and partly in the Argentine, are more magnificent than either Niagara or the Victoria Falls.

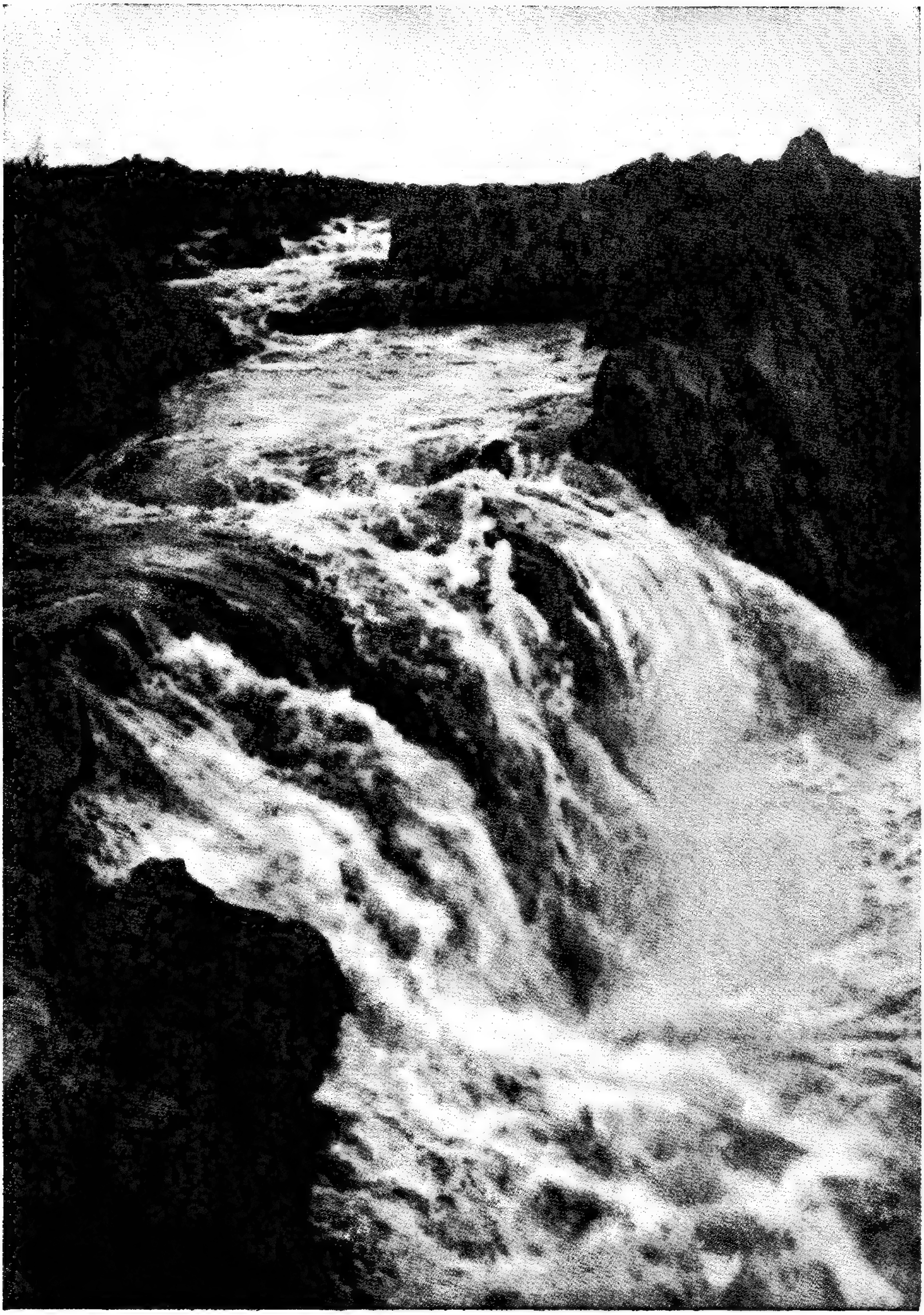
wonderful waterfall in the heart of the forests, and some of the priests are said to have seen it. But the Jesuits were expelled from South America while the country was still under Spanish rule, and all records of the existence of the great waterfall were lost. Then, some years ago, when the boundary between Brazil and Argentina was in dispute, surveyors re-discovered the great falls of the Iguassu river, and found in them one of the greatest natural wonders of the world. The fact



(Illustrations Bureau.

THE NIAGARA FALLS IN WINTER.

of their existence was made known, but it is only in the present century that their extent and magnificence have been realized. Even now few people have seen them, hidden away as they are in the heart of virgin forest country, beyond Asuncion, the little-known capital city of Paraguay. The banks of the falls are tree-covered, and day and night the trees drip with the spray thrown up by the great volume of water pouring over the cliffs. Like Niagara, the Iguassu Falls are



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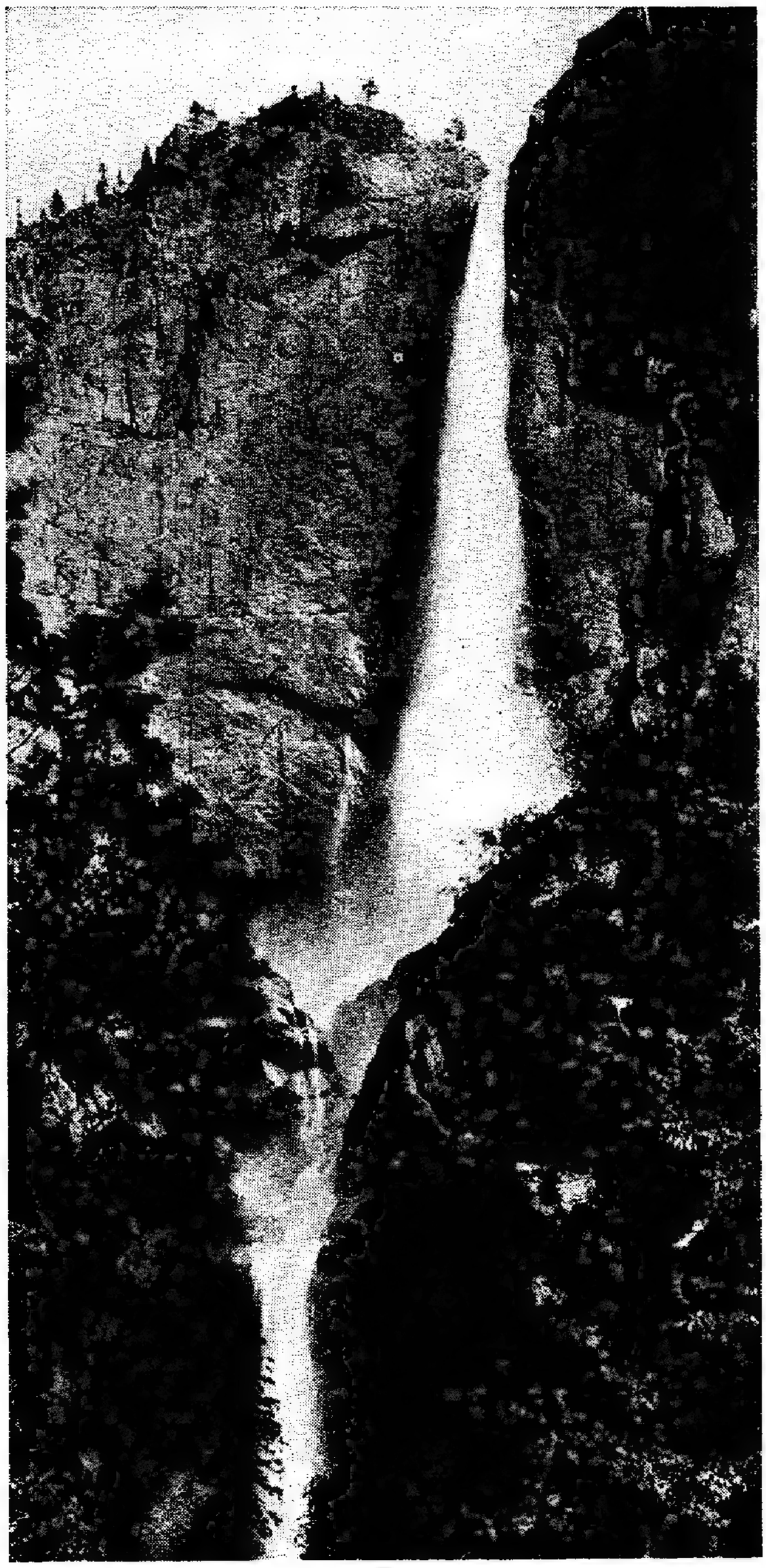
THE FALLS OF THE POTOMAC, NEAR WASHINGTON.



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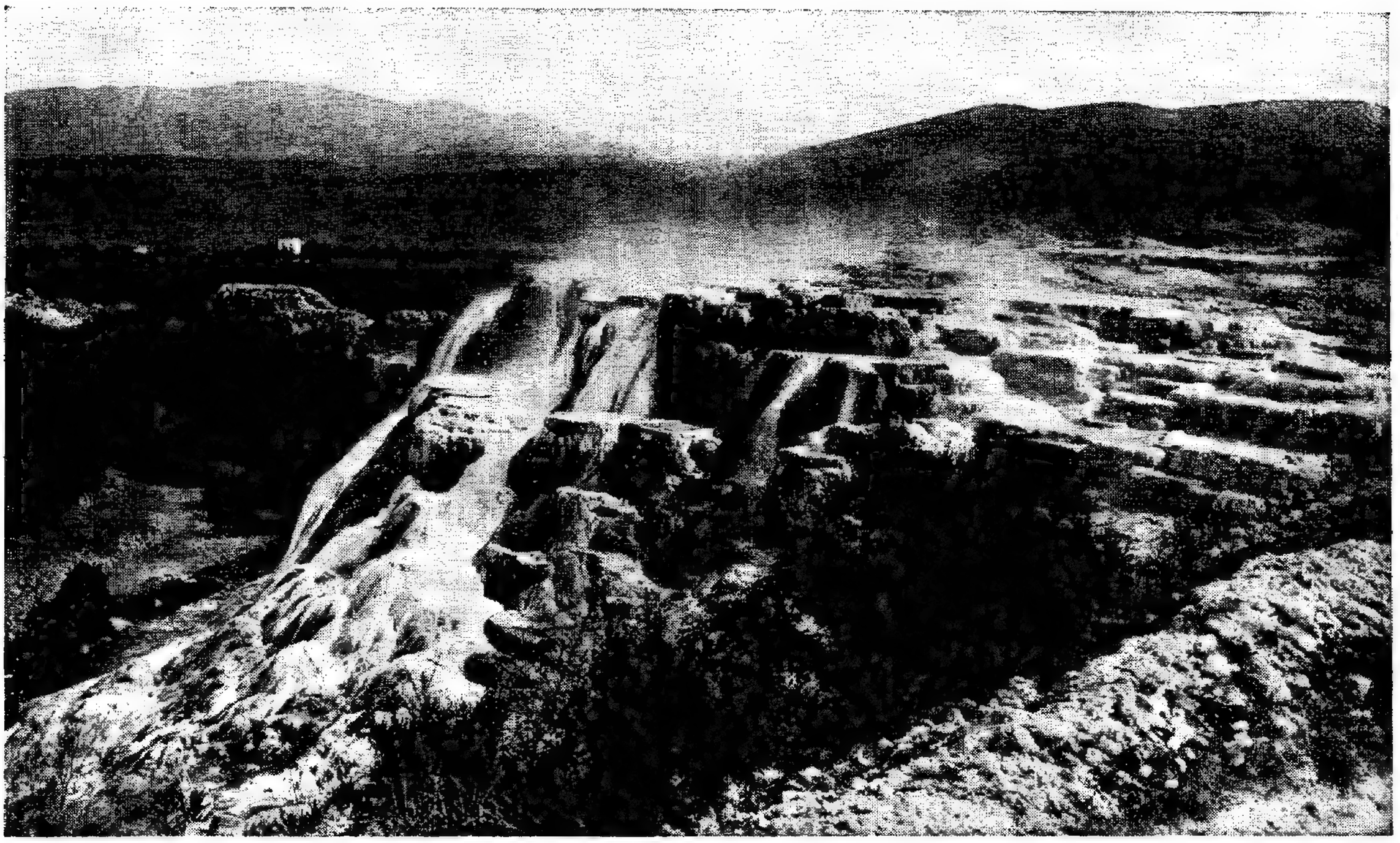
THE YOSEMITE FALLS.

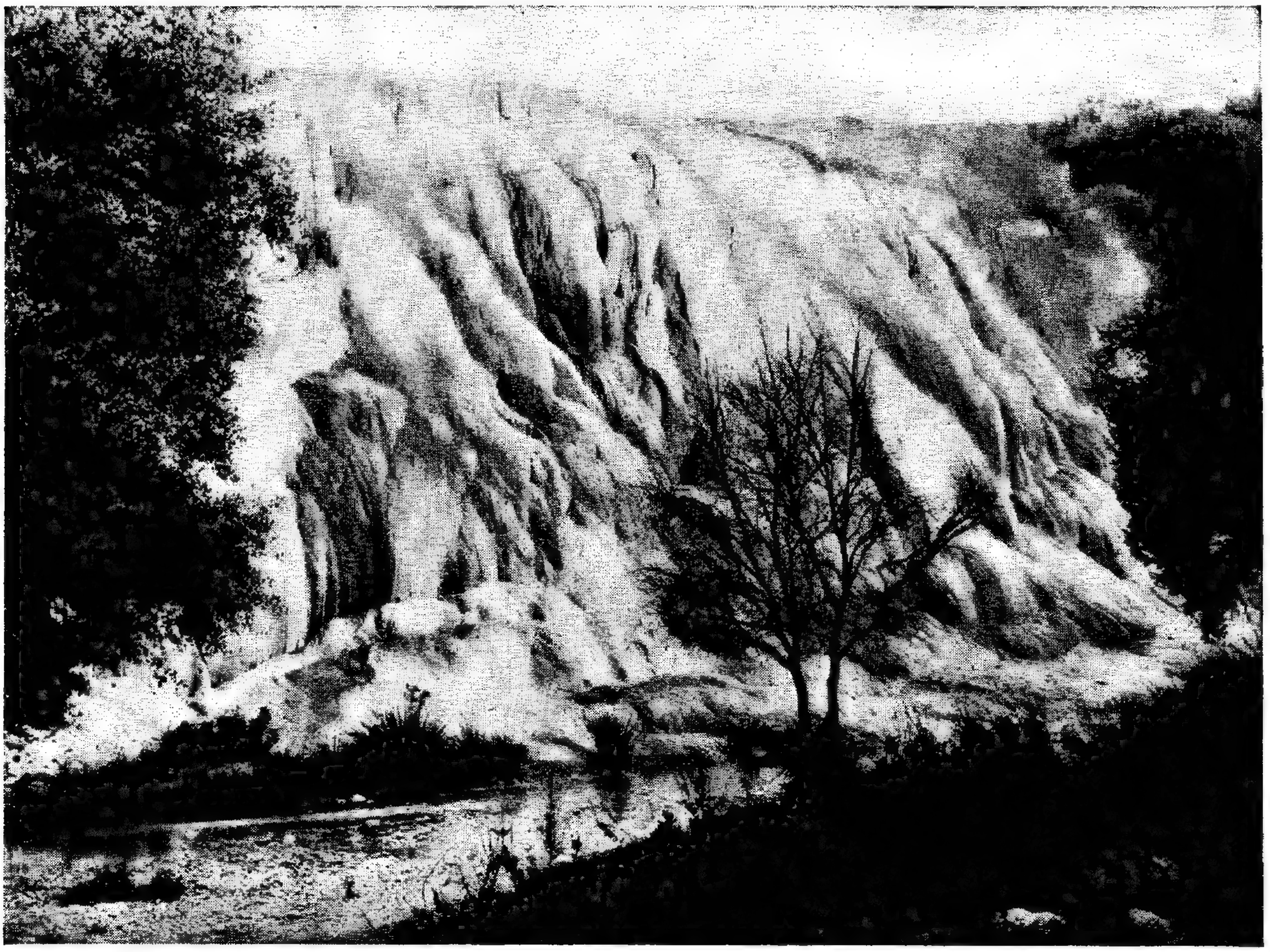
One of the highest waterfalls in the world. It takes a first leap of 1,500 feet, then come a series of cascades for 600 feet, and a final plunge of 400 feet.

roughly horseshoe shaped, and pour down into a great gorge through which the river runs in dangerous rapids toward the junction of the Iguassu river with the wide Parana.

Another magnificent waterfall is that of the Potomac River, near Washington, U.S.A. Here the volume of water is not great, compared with Niagara or Iguassu, but the rocky, tree-clad banks of the river, and the broken masses of water pouring among the rocks of the river-bed, make up a scene which attracts tourists in thousands throughout the summer months.

What were perhaps the world's most beautiful waterfalls, the "Pink Terraces" of Rotomahana, New Zealand, were destroyed by volcanic action about forty years ago. For centuries water impregnated with silicon had been flowing over terraces of rock; this water was almost at boiling-point as it gushed from the earth, and as it cooled it left a deposit of silicon on the rock terraces, a deposit that was like powdered glass of a delicate pink colour. This wonderful series of steps, with the water flowing over them, was situated amidst most beautiful mountain scenery, and when the earthquake destroyed it New Zealand lost its most splendid natural wonder. But the country which produced the "Pink Terraces" is full of hot springs issuing from the ground, and similar terraces are forming in other places at the present time. Such formations are carefully watched and guarded, so that they may develop as rapidly as possible, but it will be many





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PETRIFIED MINERAL SPRINGS AT HAMMAM-MESKHUTIN, ALGERIA.

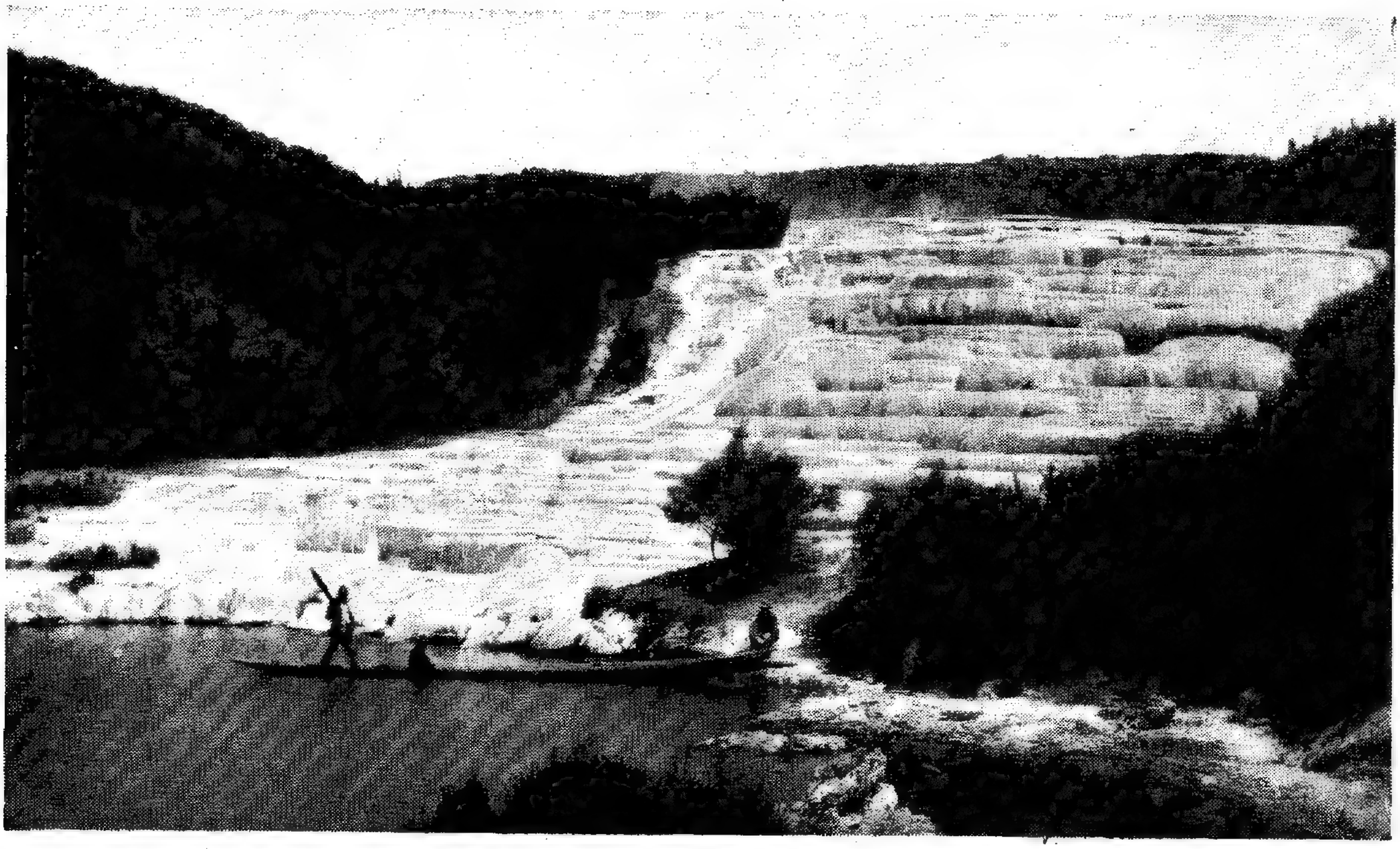
Warm water still flows copiously, but the calcareous deposits have formed huge cones, giving the appearance of frozen falls.

years before they rival the "Pink Terraces." Two of our pictures show a somewhat similar formation at Hammam-Meskhutin, in Algeria.

Both the Niagara and Victoria Falls have their electric power stations, at which great dynamos, driven by turbines which derive their power from the waterfalls, generate electric current for lighting and power uses. The generating station at Niagara produces current which supplies power to Niagara City, as well as lighting the whole of the city streets and buildings, but the power station at the Victoria Falls is, so far, only a small one, for the district is not developed enough to call for a great use of electric power.

In many parts of the world, notably in Norway and in Switzerland, waterfalls are utilized for the production of power. Switzerland, in particular, gets a great part of its electricity in this way, and the harnessing of waterfalls is a problem that engineers are constantly considering, since, as is explained in another article, the weight of falling water is in itself power, without the use of fuel or the expenditure of energy of any other kind.

E. CHARLES VIVIAN.



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THE PINK TERRACES, ROTOMAHANA, NEW ZEALAND.

These beautiful petrified terraces were destroyed by volcanic action about forty years ago.

[F. Skeen & Co., Colombo.

THE SACRED BÔ TREE, CEYLON.

The oldest tree with a recorded history in the world. It is reverenced by millions of people.

The Sacred Fig Tree of Ceylon

NO other tree in the world is so venerated and worshipped as is the "Peepul" (*Ficus religiosa*) of India and Ceylon. A good Hindu, on seeing one, will take off his shoes and walk five times round the tree, worshipping, because he believes that the spirits of the three gods Brahma, Vishnu and Shiv, dwell within it. He would never venture to destroy one.

The sacred Bô Tree of Ceylon is a Peepul, and the most historical tree in the world. Although it is now over two thousand two hundred years old we know all about it from its very birth. In 288 B.C. a little branch was broken off a certain holy tree in India under which Buddha himself had meditated, and this branch was sent to the King of Ceylon. It was received by princes and planted with great ceremonies which were recorded in the Sacred Books, and ever since records have been kept of it. We know that seventeen hundred years ago a wall was built around it; that a thousand years ago a temple was erected in its honour, that two hundred and fifty years ago it was struck by lightning, and many other details. The prosperity of Ceylon and of the Buddhist religion is supposed to be bound up with the tree, and it is the object of much veneration. Unfortunately, it is now very old-looking and almost decrepit, as our picture shows.

[*Fleet Agency.*

BEES FOR HIS BONNET.

This helmet and chin strap are composed entirely of live bees. The man did not receive a single sting.

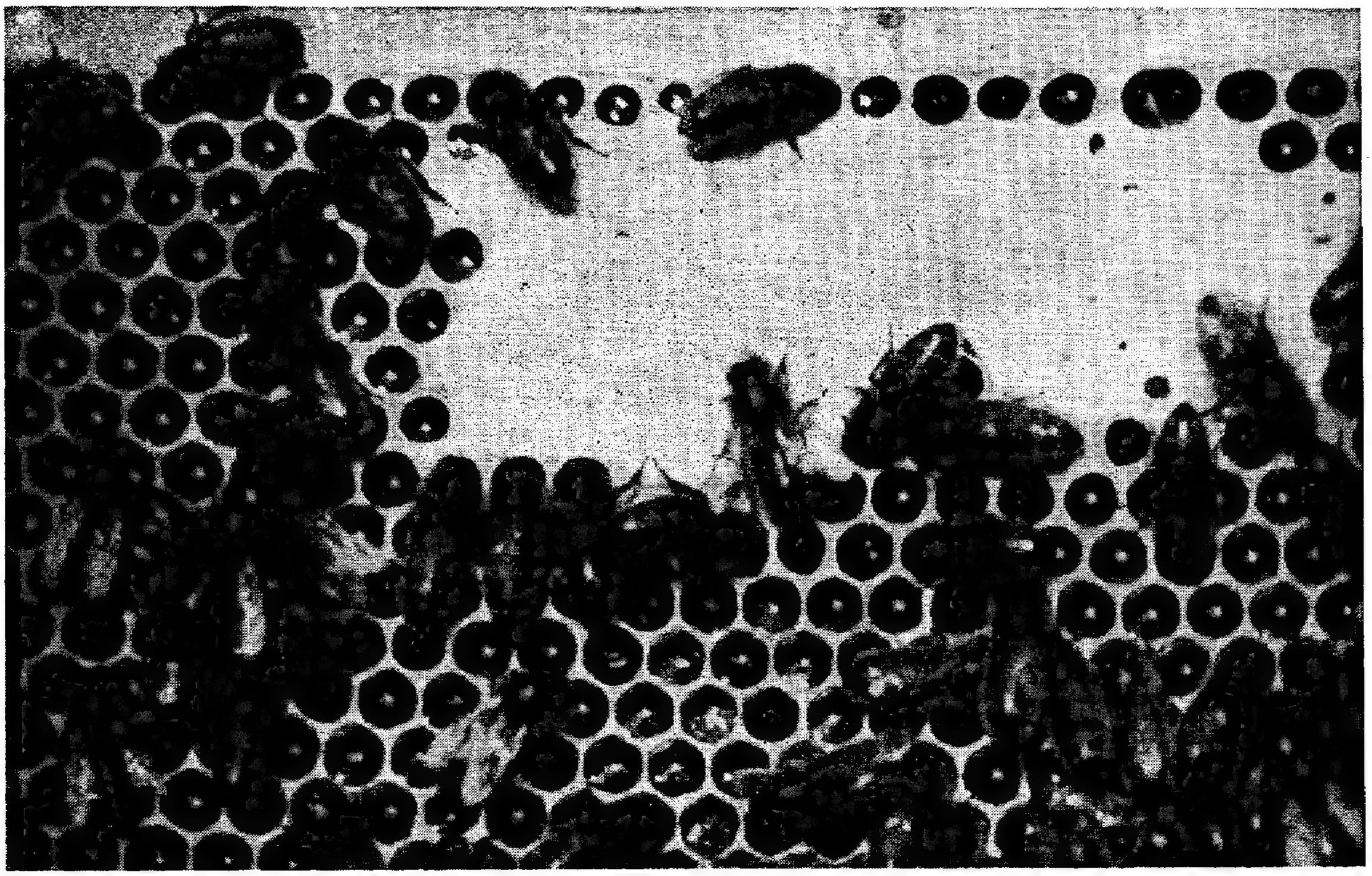
The Wonders of the Hive

WHEN you have watched bees at work in the garden, have you ever thought how wonderful are the lives they lead and how a bee city resembles in many ways our own communities? For a beehive is really a city, with soldiers, food gatherers or foragers, bread-makers, undertakers and a host of other workers to the number of perhaps 50,000 or 60,000. Every fine day in summer and early autumn the gates of this bee city will be crowded with busy workers, passing in and out of the hive in hundreds, each bent on some special errand.

Everybody knows that the bees have a queen, and that only one queen is allowed in each hive. She is larger than her subjects, but if you watch to see her leaving her kingdom you will almost certainly be disappointed, for she never leaves the hive—not even on the finest day—except on one or two state occasions. Hers is not a life of pleasure, as is sometimes the case with Royalty. She would indeed be better named "the bee-mother" rather than the queen, for it is not

strictly correct to say that she rules the hive. She is waited upon, groomed and fed by her royal attendants, who also guide her through the bee city when she moves about. These attendants surround their queen in a circle and—as in royal practice—if they can avoid doing so, they never turn their backs upon her.

Each of the many thousands of workers has certain duties. All are busy and laziness is unknown to them. Some bring water from neighbouring streams by standing on a pebble or branch and dipping their long tongues into the water. Others gather nectar and pollen from the flowers and hedgerows. In the hive itself the builders may be at work repairing some damage, or erecting new cells or bee-cradles. In these cells the young bees are reared from eggs laid by the queen and are carefully tended by nurse bees. Soldier bees guard the entrance to the hive and allow no strange bees to enter. How they distinguish their own kin from strangers we do not know, for all bees look alike, or nearly so, to us. Perhaps some password is given, or more probably the bees depend for recognition on the sense of smell of the sentries. Stationed close to the gate are ventilating bees, whose duty it is to keep the temperature of the hive uniform. On cold days they prevent heat from passing out of the hive by fanning with



Photo] [*Ellison Hawks.*

BEES SEALING OVER THE HONEY-CELLS.

It will be seen that the unsealed cells are full of honey.

their wings; on hot days and nights they cleverly draw the cool evening air into the hive in a similar manner.

We do not know how these various duties are determined and assigned, or by whom the orders are given, but everything is precisely arranged in some mysterious manner. Certain it is that there is no quarrelling as to who shall gather pollen or who shall be on guard—each bee seems to know exactly what to do, and, moreover, always seems to be doing it!

No more wonderful sight is to be seen than the bustle at the door of the hive, and one may sit for hours watching the activities of the workers. Bees are constantly alighting on the board, coming so

Photo] [*Ellison Hawks.*

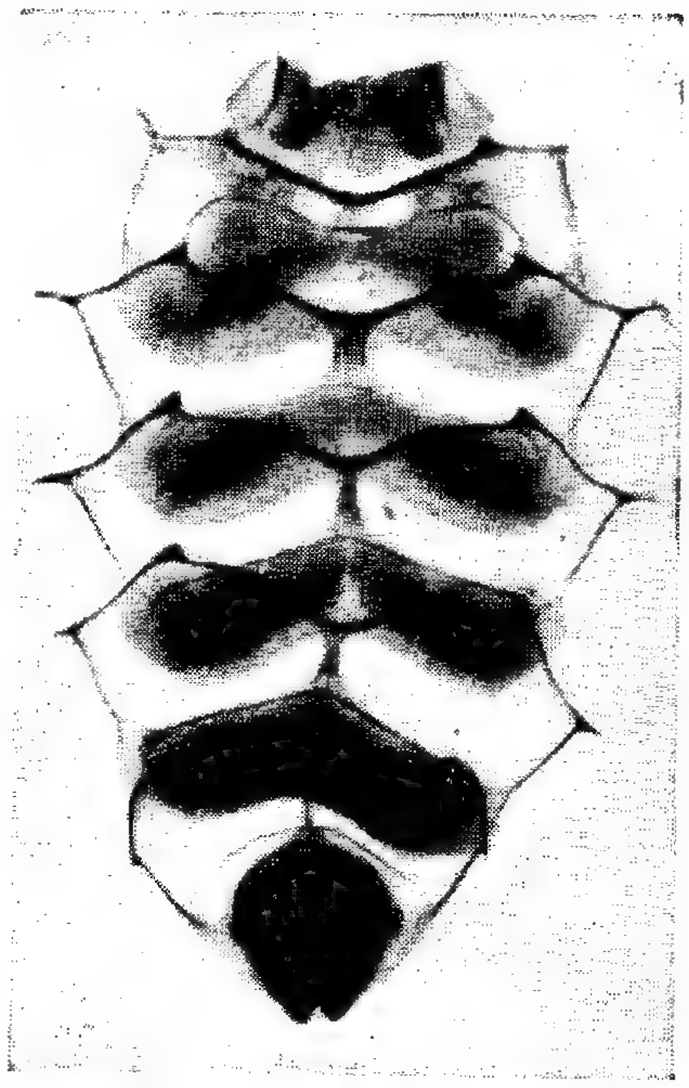
BEES ENGAGED IN VARNISHING SEALED-OVER CELLS.

In several of the open cells can be seen pellets of pollen—the "flour-bins" of the hive.

quickly that they appear to spring from nowhere. Others come out of the hive and fly away just as rapidly. Some who come to the gate do not seem to be in such a hurry, for they stand on the board brushing their wings. These are young bees who have probably never before been outside the hive and are unaccustomed to the strong sunlight. Some of the bees returning to the hive have two brightly-coloured spots on their hind legs. These are the pollen gatherers, who collect the "bee-flour" and thus resemble dusty millers.

Watching the door of the hive thus I have sometimes seen two bees struggling desperately. To and fro the fight has raged, and on one occasion the struggle continued for half an hour or more. One of the bees was a soldier bee; the other was a stranger who had

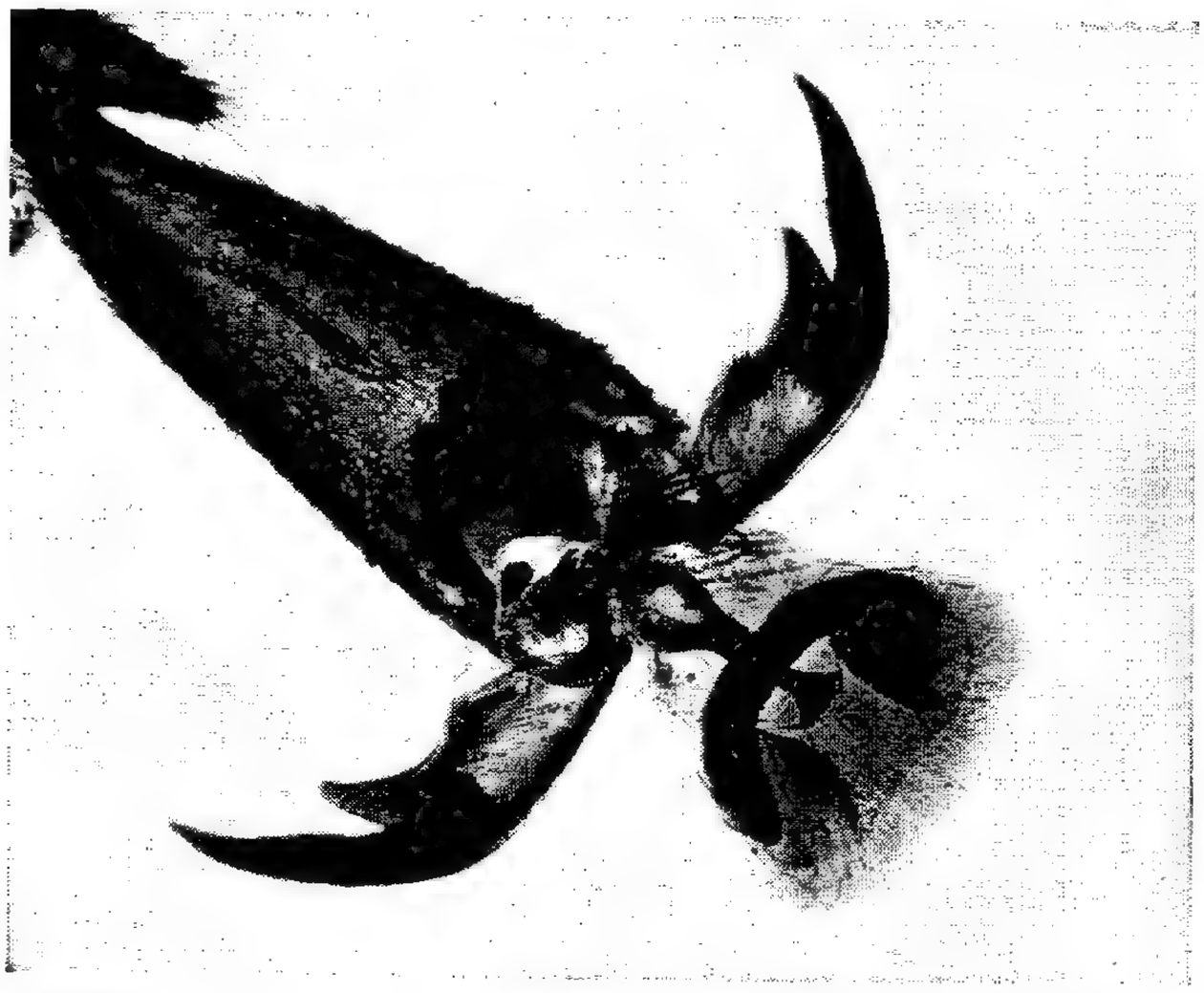
tried to enter the hive to steal honey but had been caught by the sentry. The pair rolled over and over on the boards, struggling this way and that, each trying to get the better of the other. At length they fell to the ground and continued the struggle in the grass. Eventually right won the day; the guard bee stung and killed the would-be robber, and, after giving the dead body a contemptuous push into the long grass, returned to the hive in triumph.



Photo] [*G. H. Hewinson.*

A wonderful photograph of the underside of a worker bee, showing the wax pockets.

In addition to the workers already mentioned, there are scavenger bees, whose duty it is to keep all the combs spotlessly clean. They are assisted by undertaker bees to bear away the bodies of workers who may have died within the hive, and in winter they have a busy time, for the cold may kill off many hundreds of bees a day in each hive. Sometimes the watcher at the door of the hive will see the undertakers carrying out an object that resembles the ghost of a bee—a bee in form but with folded wings and a body of pearly white. This is a young bee that has died before birth, so that its cell has been both cradle and tomb. The dead bees are carried away to some distant burial ground, so that their decaying bodies may not pollute the surroundings of the hive.



Photo] [*G. H. Hewinson.*

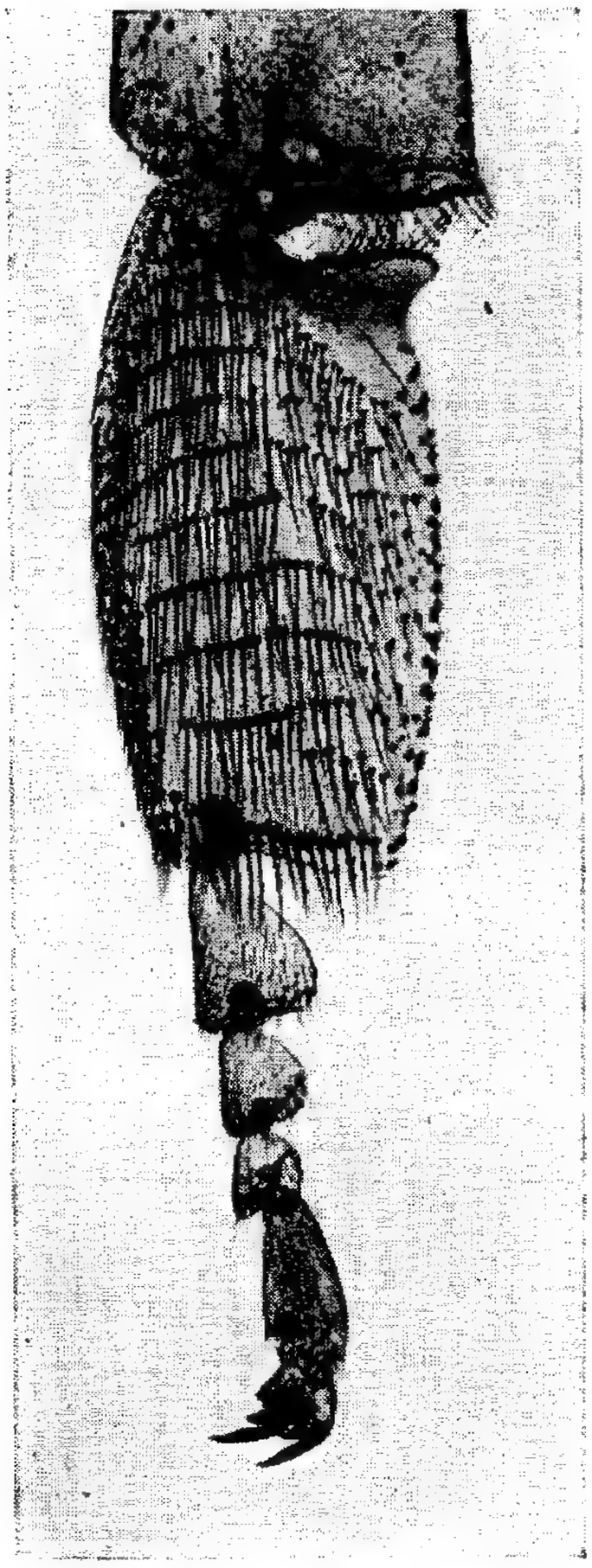
A BEE'S LEG,

showing "sucker" and claws, by which the bee is able to climb up either smooth or rough surfaces.

When a swarm of bees first enters an empty hive, numbers of them climb to the roof and fasten themselves by means of their tiny claws to points of vantage. Other bees join them, each hooking its claws in those of another. In this manner chains of living bees hang from the roof in festoons that become so numerous as to resemble a large cluster. Meanwhile the scavenger bees

clean up the floor of the hive, removing twigs, leaves, stones and other foreign bodies. In perfect silence there then begins the mysterious process of wax-making.

Underneath the rings forming the worker's abdomen are light wax "pockets," shown in the photograph on the previous page, and in these are formed tiny flakes of wax. When this has formed, the wax-pincers on the bee's hind leg take the wax from the pockets and pass it to the front legs. By mixing with it juices from the mouth-glands the bee soon makes the hard and rough wax pliable and smooth, in which condition it may be moulded into any required shape. It is then taken to the highest point of the hive and there fixed in position, so that it becomes the "foundation-stone" of the new comb, because in a bee city building always begins at the roof and is continued downwards to the floor.



Photo] [*G. H. Hewinson.*

THIRD LEG OF WORKER BEE

showing wax-pincers in joint of leg and the spike-like hairs, arranged in rows.

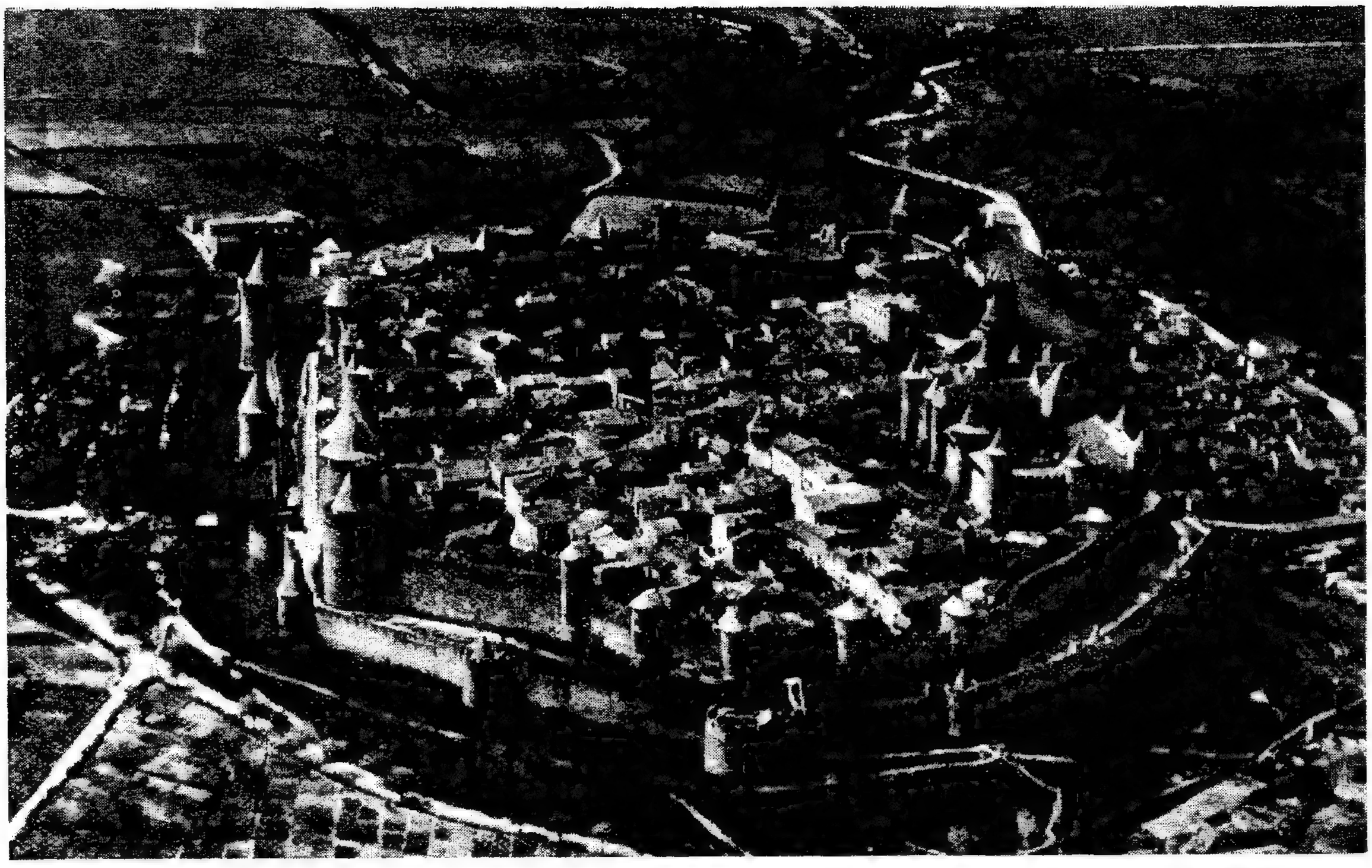
The wax is moulded into hexagonal or six-sided cells, for cells of this shape do not occupy as much space as would cells of any other shape. How the bees found this secret out, we do not know; but this is only one of many problems we have yet to solve in connection with bees. The cells may be cradles for the young bees, or store cells for honey or pollen. The purpose for which the cells are required determines their size, for they vary very slightly in their dimensions. New cells are beautifully clean and white, but in time they become discoloured and even as black as soot.

Short as this article is, I hope it will be the means of leading you to study bees for yourselves. If you do so you will speedily realize that among the many wonders of the world there is nothing more wonderful than a bee city.

ELLISON HAWKS.

A SECTION OF BROOD COMB.

Showing the Queen Bee, easily distinguished by her longer body, surrounded by workers. In some of the cells can be seen grubs in various stages of development. At the bottom left corner are three queen cells, one sealed, one from which the queen has emerged, and one torn open, telling a sad story of a needless queen destroyed by the reigning sovereign.



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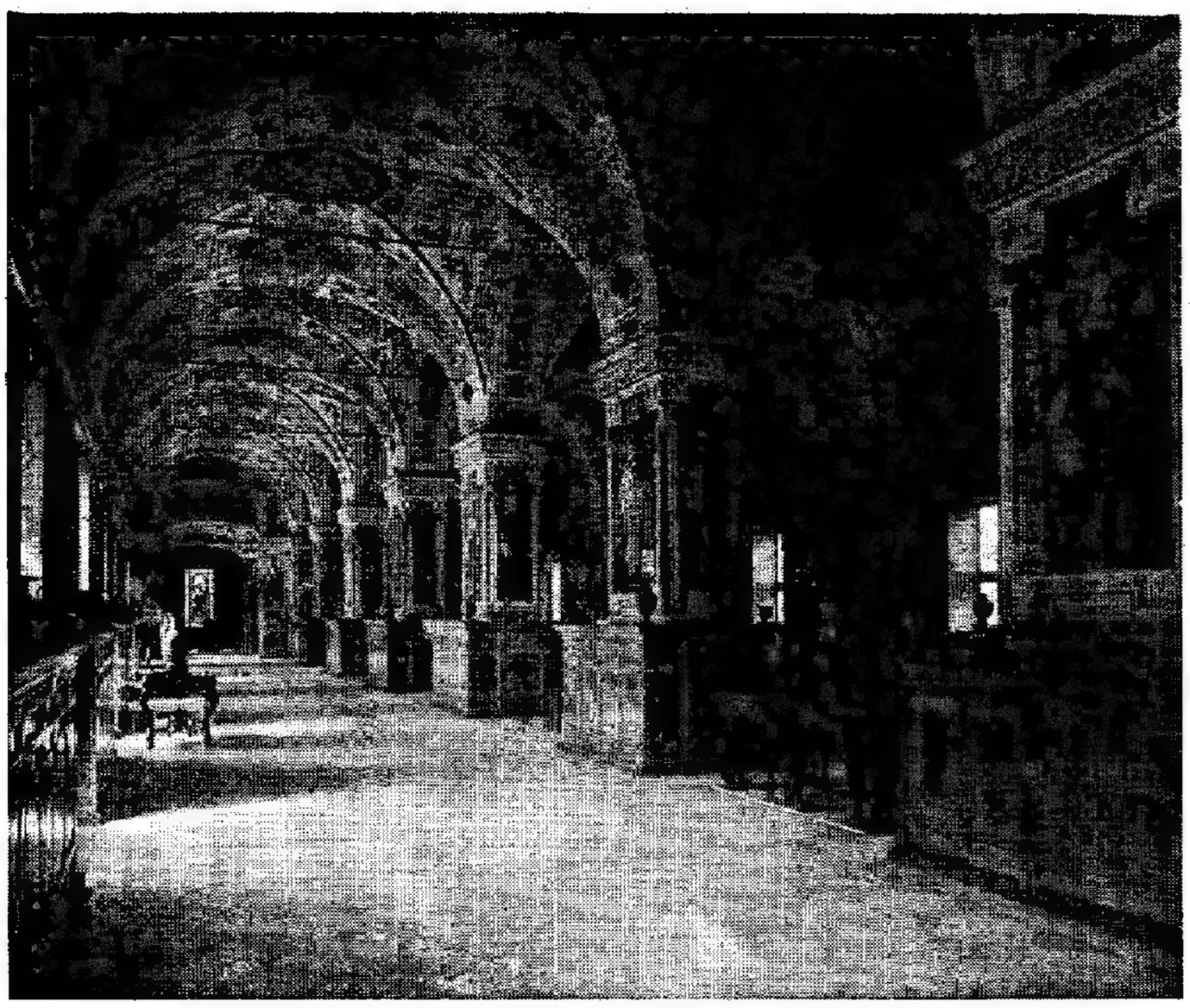
A SPLENDID EXAMPLE OF A DOUBLE-WALLED FORTRESS TOWN OF THE MIDDLE AGES.

"Fair Carcassone," in the South of France, an exceptionally well preserved old city, with fifty-two towers. The double walls make a circuit of over a mile.

Cities Within Cities

THE Vatican is a wonderful city in itself. It contains some of the greatest treasures of the world, and to it belongs the greatest church in the world, St. Peter's Cathedral. As a protest against the revolt of Italy from papal rule, the Pope of these days never steps outside the Vatican once he has been elected; in that little city, which is a city inside Rome, he is virtually a prisoner for the remainder of his life. Within the Vatican he maintains his own little army of guards, and his own separate Government. His palace is a state in itself, a sign of the temporal power that once belonged to the Church of Rome, when the authority of the Pope ruled the world.

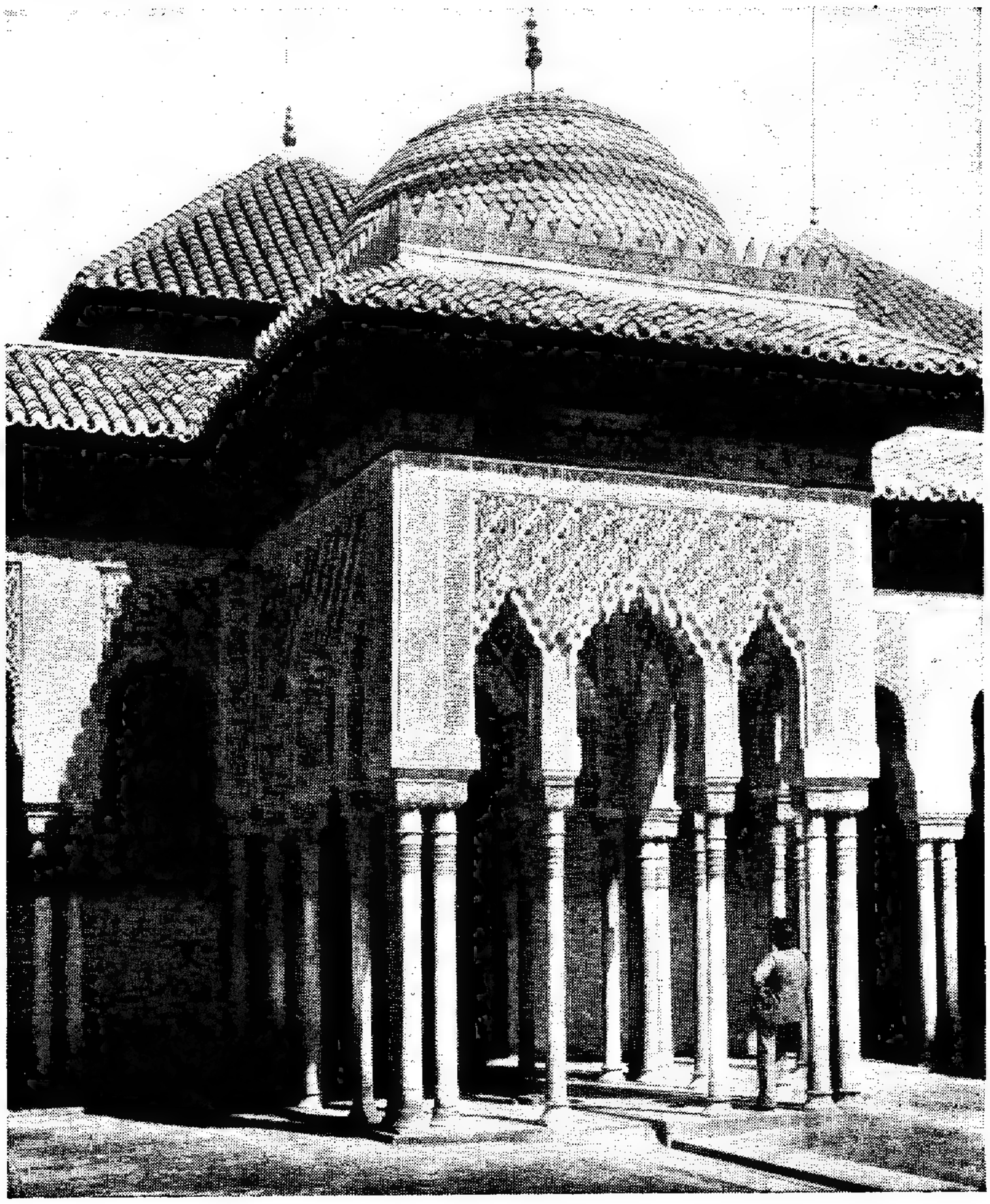
A city within a city of far different character is the famous Alhambra, of Granada, the centre of the old Moorish Government in Spain. This fortress-citadel stands on a rocky eminence which commands Granada itself and the country round it. The original name, "El Hamra," signified "red rock." The Alhambra is surrounded by a wall of over a mile in circumference, within which were beautiful gardens, a citadel, the famous gate of justice, and the palace, of



[G. Brogi, Rome.

THE VATICAN LIBRARY.

which two great courts and some minor buildings remain. These two courts are the "Court of the Lions" and the "Court of Blessing." Outwardly they are plain structures in the Moorish style, but each within is a blaze of mosaic and beautiful carving, enamelled tiles, and marble decorations. Two smaller buildings, the beautiful Hall of the Abencerrages and the Hall of the Two Sisters, and a maze of smaller apartments, are standing too. Our photographs show portions of the lovely stone lacework, the marvel of which is increased when it is remembered that it is not meaningless decoration, but is a complicated arrangement of Arabic poetry and verses from the Koran. After the Moors were driven out of Spain, much of the Alhambra was destroyed, and the French, during the Peninsular



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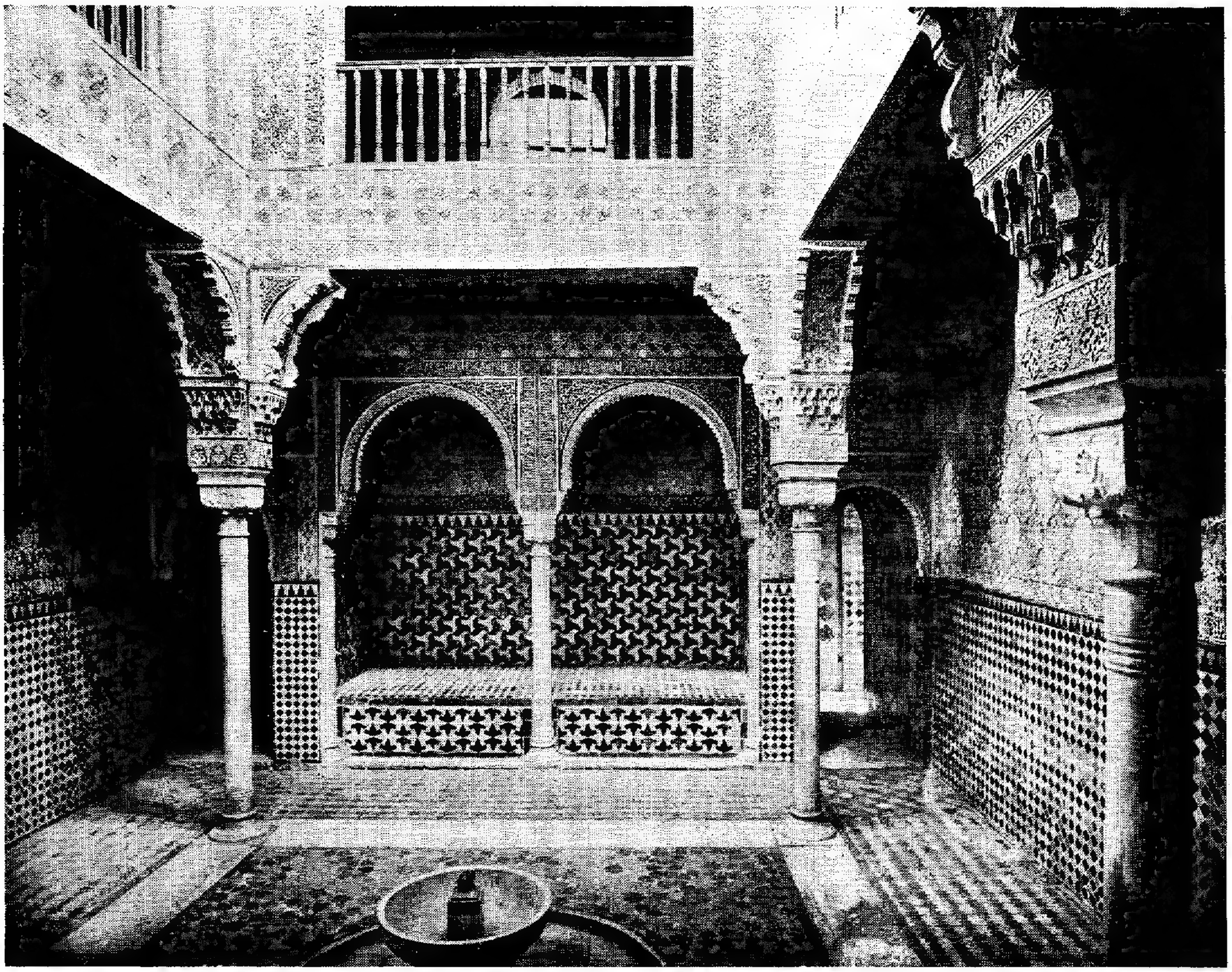
PAVILION IN THE COURT OF LIONS, THE ALHAMBRA.

War, blew up one of the principal towers, but enough remains to make this beautifully decorated building one of the wonders of the world.

The Alhambra is a place of many romantic legends, one of which concerns a great walled-up doorway, of which it is said that Boabdil, when he surrendered the keys to the conquering Spaniards, requested that the gateway by which he rode out from his palace might be walled



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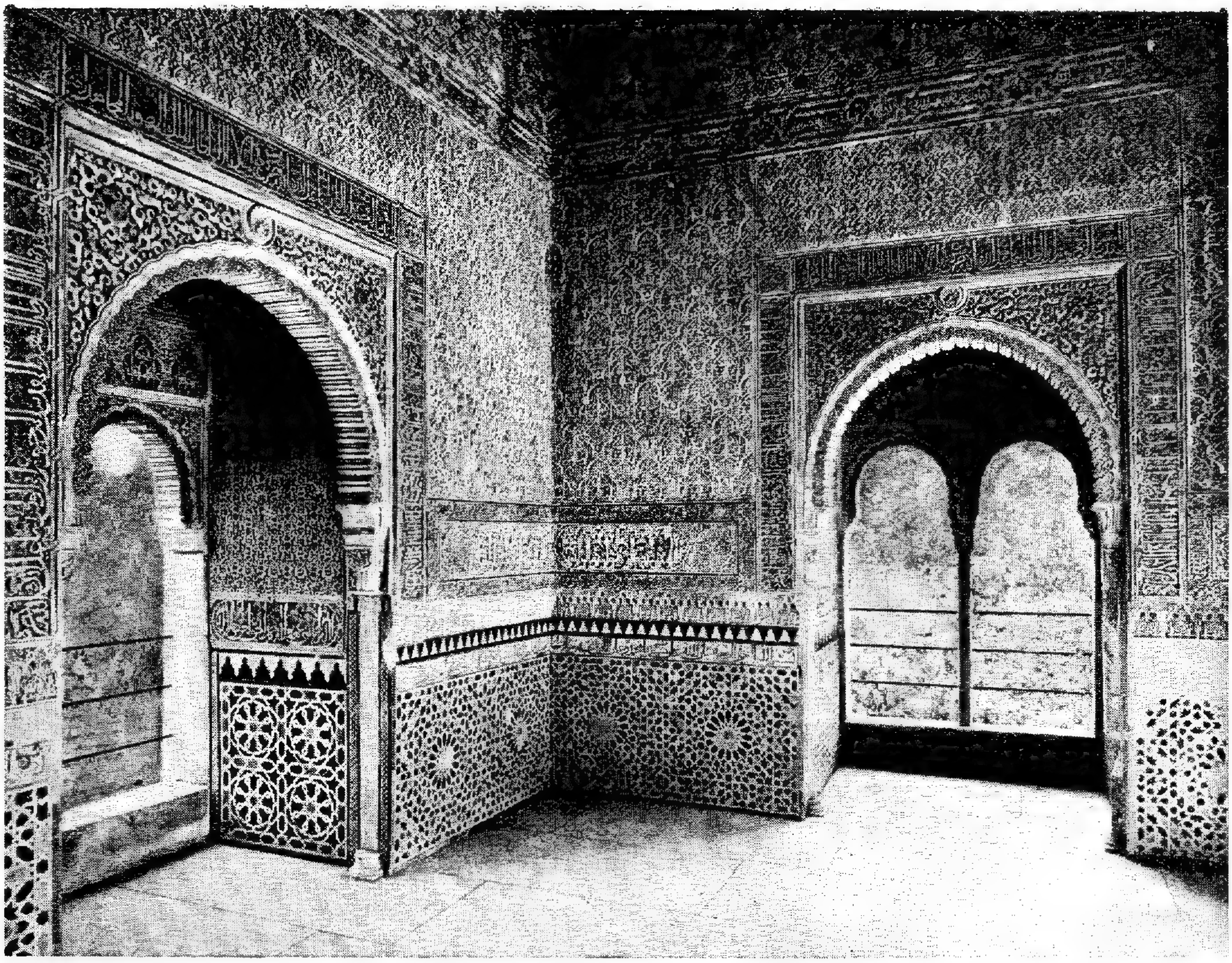
HALL OF REPOSE, THE ALHAMBRA.

up, so that no other should ever pass through it. His request was granted, and the closed gateway is still shown in proof of the story.

Another city within a city is the Kremlin at Moscow, where, from the time of Ivan IV down to the recent Russian Revolution, all the Czars were crowned, and most of them were buried. The Kremlin is to Moscow what the Vatican is to Rome, a city within a city, containing the royal palace, two cathedrals, many churches, and the palaces of the former nobility of Russia.

Standing on an eminence in the city of Moscow, the Kremlin is like a fairy palace, with its gilt towers and domes and its white walls towering over the rest of the city. Throughout Russia it was regarded as a sacred spot, the centre of Russian life and history, until the Revolution came and swept away the Czars and all signs of the old rule. The Kremlin to-day is little more than a nest of buildings in which clerks work and the machinery of government is housed. The



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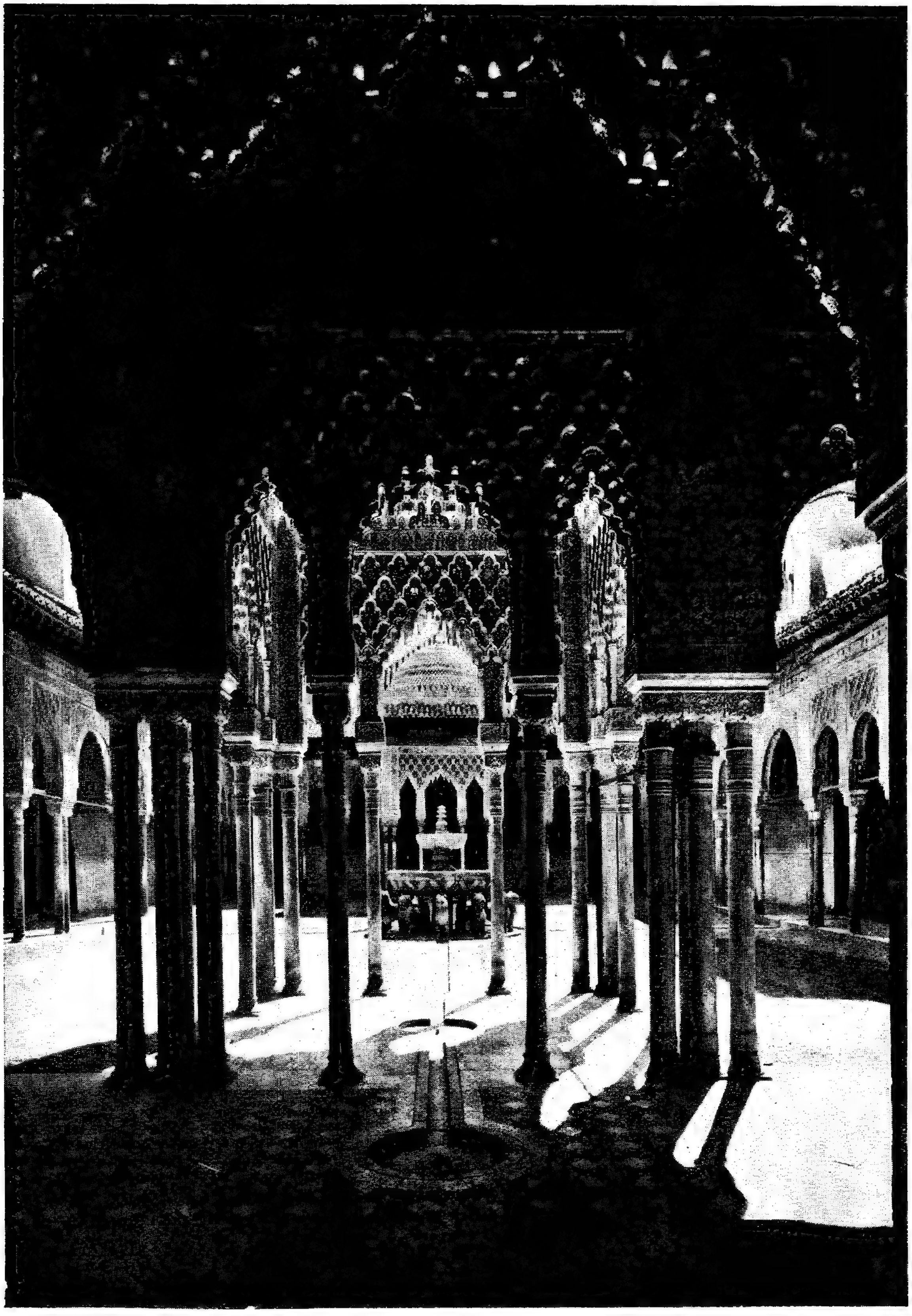
ANOTHER BEAUTIFULLY DECORATED ROOM IN THE ALHAMBRA.

buildings remain, and recent travellers in Russia—there are few of them to-day—have reported that the vast treasures gathered in the cathedrals and palaces, which were said to have been pillaged and stolen, are still almost intact.

Our first picture shows the beautiful city of Carcassone, in the south of France, a favourite subject for both painters and poets. Though not strictly a "city within a city," it is a fine example of a military double-walled town. It is said to have "a tower for every week in the year," and the walls are a mile round.



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COURT OF THE LIONS, THE ALHAMBRA.

[*Topical.*

THE KREMLIN, MOSCOW.

Much has been heard of late of this famous "city within a city." If its stones could speak, what tales they would tell!

[*E.N.A.*

THE GREAT BELL IN THE KREMLIN AT MOSCOW.

This is believed to be the largest bell ever cast. It came cracked out of the foundry in 1653, and has never been hung. It is 19 feet high, 60 feet round the rim, and weighs 198 tons.

Plants that Eat Insects

WE are so accustomed to think of the animal world living on the plant world that it comes almost as a shock to learn that sometimes the process is reversed. There are, however, quite a number of innocent-looking plants that deliberately trap and feed upon insects, and some of them are to be found even in Great Britain.

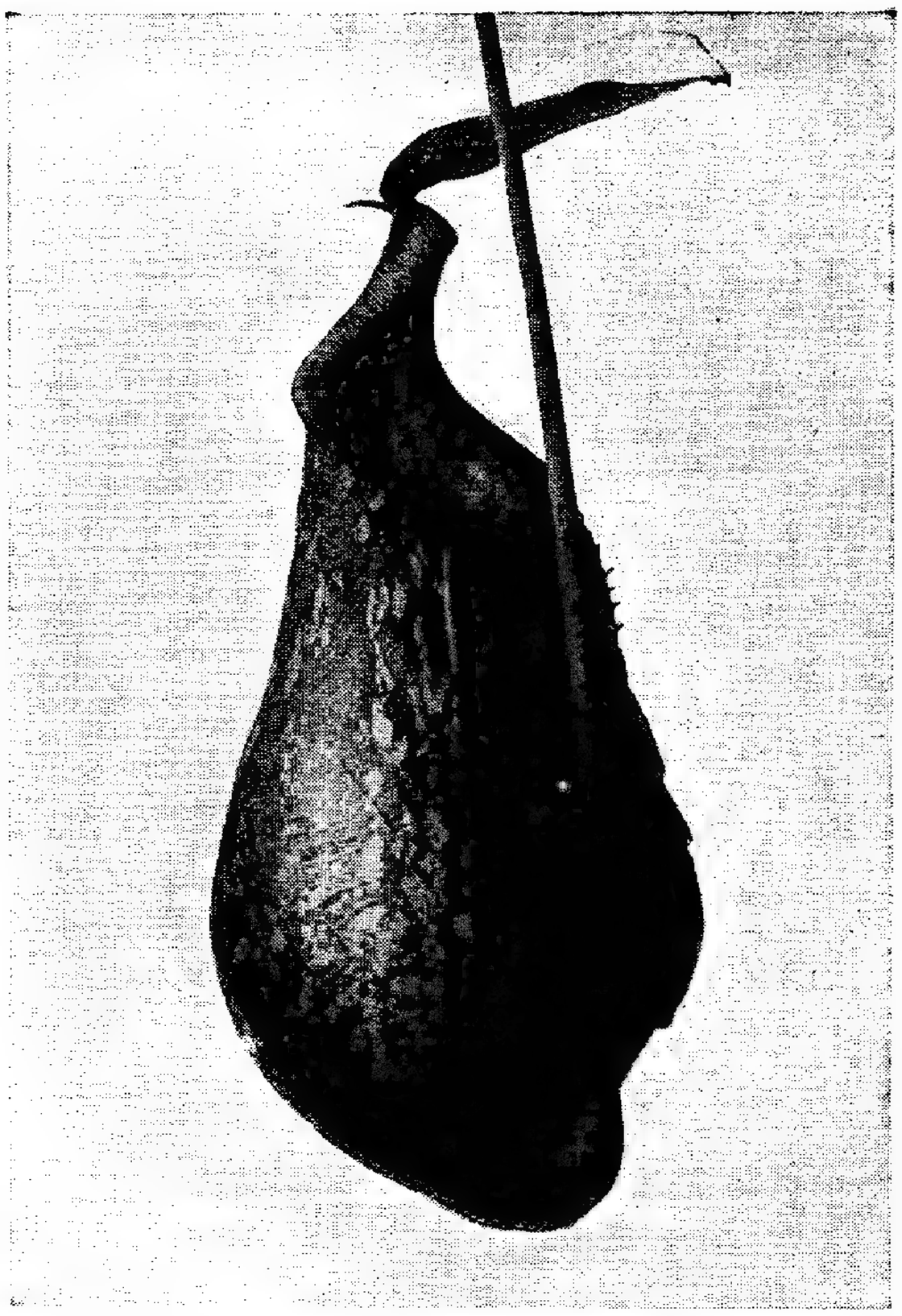
On the moorlands above the sea in California grows one of the cleverest and cruellest of plants, known as the Side-Saddle Plant, or Darlingtonia, illustrated on page 185. Its leaves and leaf-stalks have developed into tall circular vessels, with a hood arching over each to keep out the rain. From the front of the hood hangs, over the opening, a curious fish-tail shaped object. Through both it and the hood run red and purple veins, so that at a little distance they form flower-like patches of bright colour. This is the lure.

Between the veins in the hood the tissue is thin and semi-transparent, so that a little glimmer of light can pass through. These windows are for a fell purpose.

Round the opening under the hood honey is spread. Flying insects of all sorts, seeing the bright lure, go gaily towards it and there find the honey-bait lying before them. Eagerly they sip it and during their little orgy alight on the slippery inner side of the vessel. They find no foothold, and, fluttering, try to escape. But the true way out is covered by the fish-tail object, and they see only the dim light coming through the "windows." Misled, they dash vainly at these again and again, as a moth dashes at a glass window, and finally fall exhausted into the vessel. At the bottom of this lies a little pool of liquid that must have oozed out of the walls, as no rain can get in, and in this liquid the victims are drowned. Their bodies decay and the liquid becomes a veritable soup, which the plant absorbs for nourishment.

The Darlingtonia sets its trap for winged insects only, but another plant rather like it, the Sarracenia, or Trumpet Plant, has an eye on wingless insects. Instead of having honey only round the rim it puts a little line of it on the outside all the way up from the ground. Thus ants and similar creatures are lured to crawl up the vessel and on and on until they reach the top, when they generally topple over and slide to their doom.

PLANTS THAT EAT INSECTS

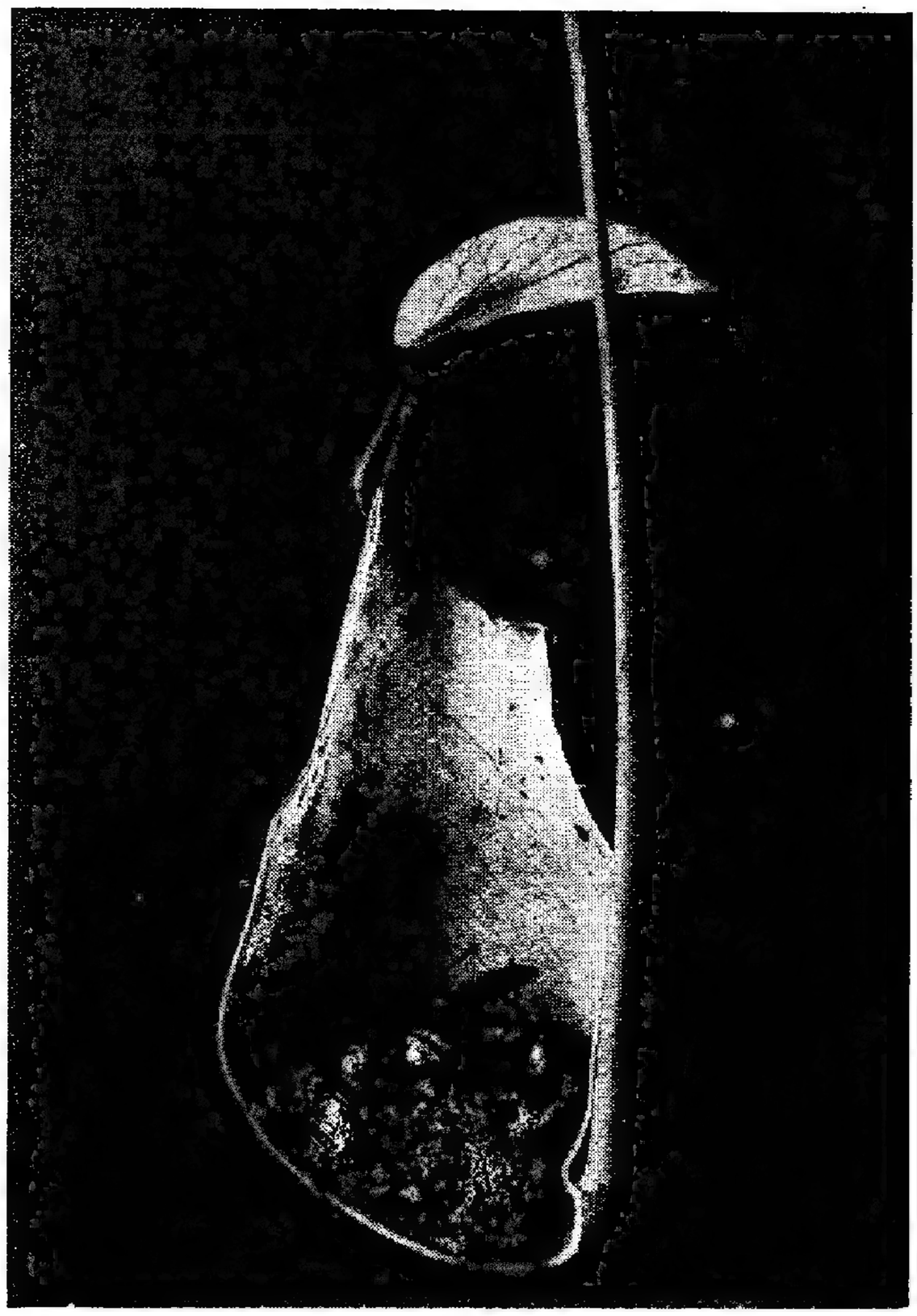


Harold Bastin,] [*Reading.*

A "PITCHER" PLANT.

In the marshes of certain tropical countries such as Ceylon and Papua grow the remarkable Pitcher Plants, or Nepenthes. They are climbing plants, and their long, thin leaf stalks twine round adjacent branches and stems until they have raised themselves well above the ground. At the ends of the twining stalks hang curious green pitchers, each with a small lid suspended above. There are many different kinds of pitcher plants, and the size of the pitchers varies. Some are quite small, an inch or two high, and only insects can get in; others are quite big, say a foot and a half high, and they can hold even a pigeon.

All these "pitchers" contain water, partly rain and dew, and partly a digestive fluid. Glistening honey baits the rim and lures small animals, birds or insects. The inside of the pitcher is coated with slippery wax, and into this horrible deadly bath the victims fall. Their struggles avail them little, for cruel, down-pointing teeth keep them below until death claims them. The fleshy parts of their bodies are quickly digested by the pepsin in the liquid, and special cells at the bottom absorb them. The indi-

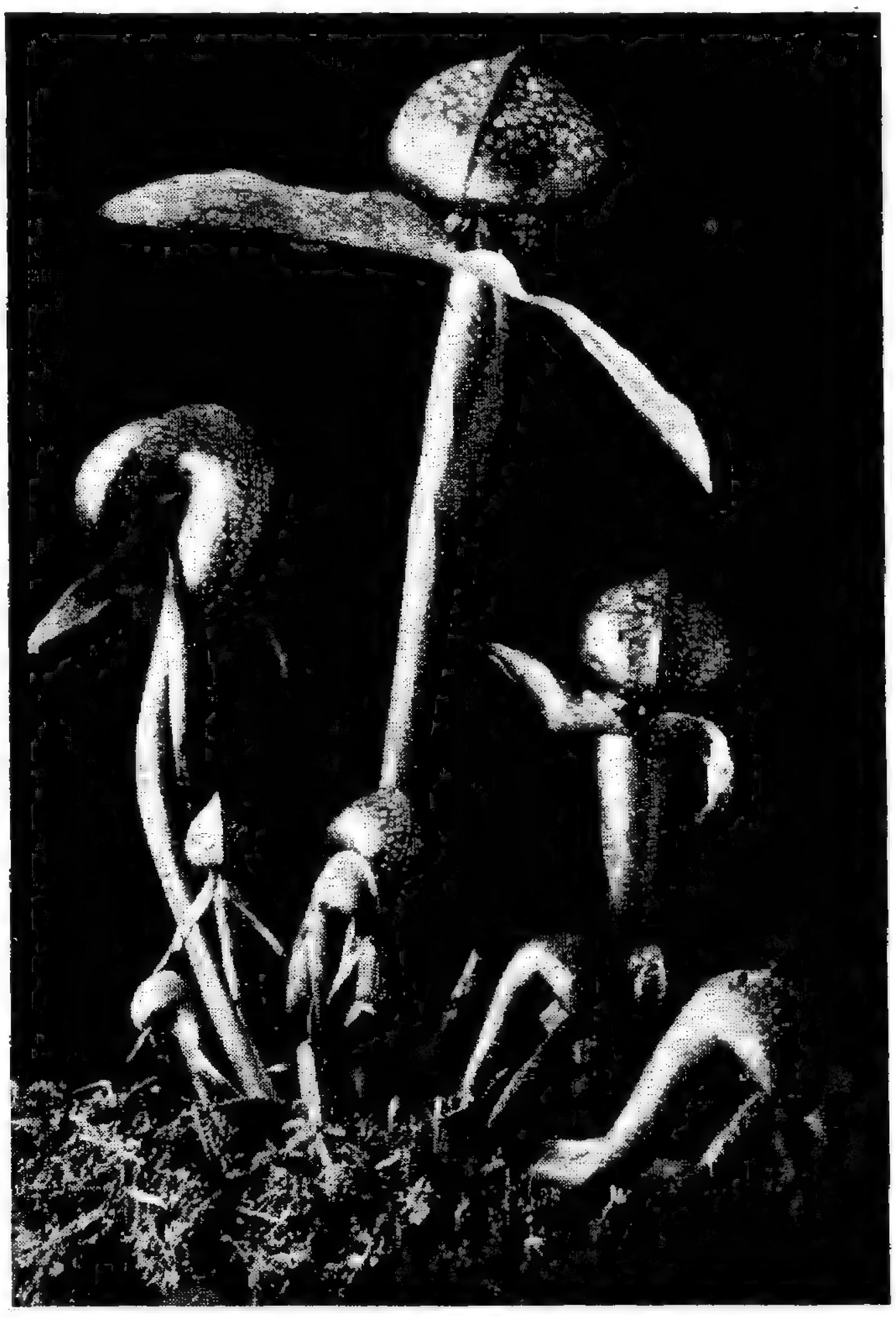


Harold Bastin,] [*Reading.*

NEPENTHES PITCHER (INTERIOR).

gestible part is left lying at the bottom of the pitcher, as our photograph shows.

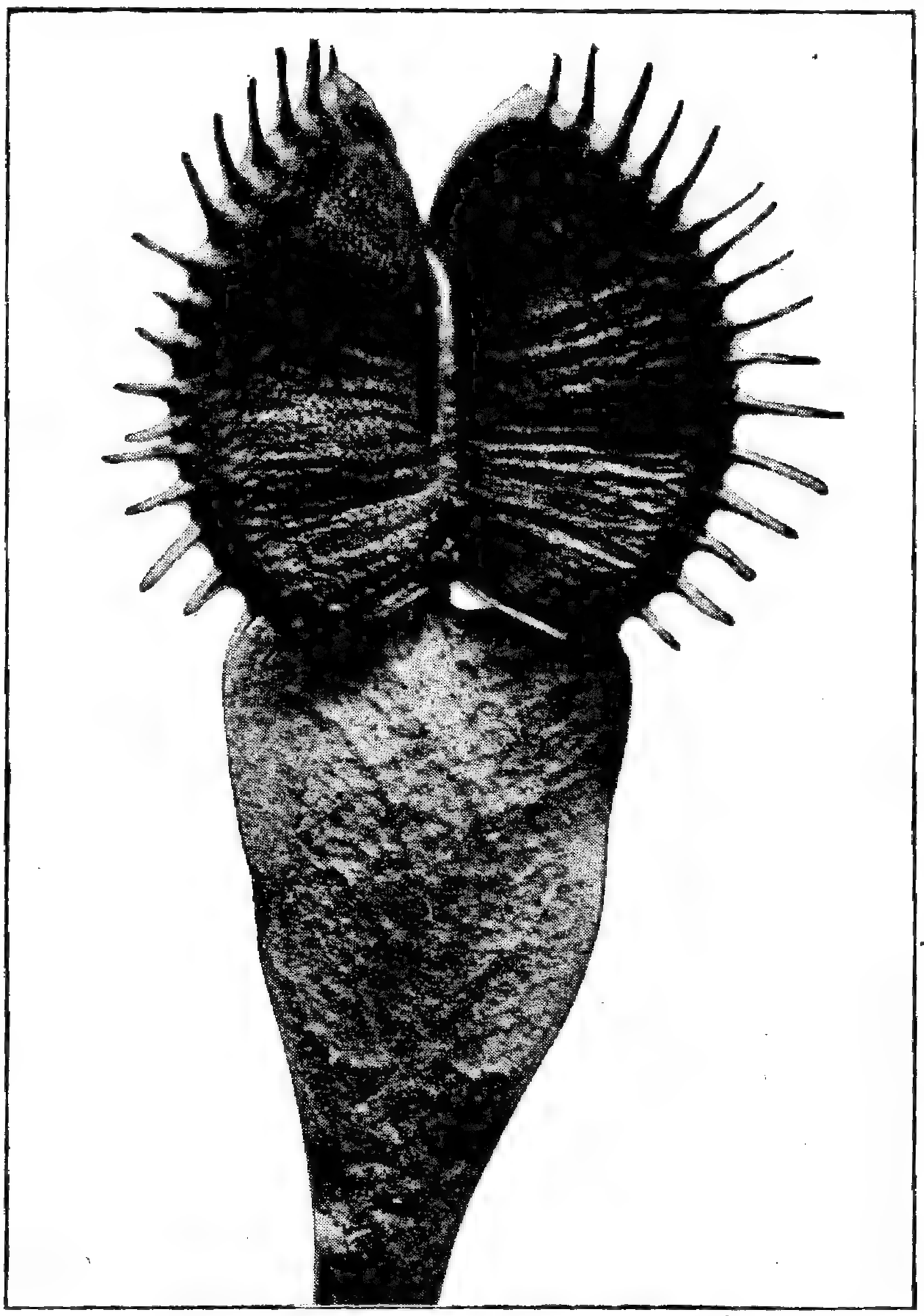
Other plants that have similar depraved appetites obtain their insect victims in other ways. The Venus's Fly Trap (*Dionæa*), a little plant that is found only in the peat bogs of a certain part of Eastern America, has, perhaps, the most ingenious insect trap in the plant world. Its leaves are in a rosette on the ground and each is divided into two parts, as can be seen in the picture on next page. The upper part is the trap and is edged with teeth. On each half of the trap are stiff bristles, and if one of these is touched this part of the leaf closes like a book. If a little fly settles on the shiny green surface it will almost certainly touch a bristle—snap goes the trap, the teeth at the margin interlock, and the fly is caught. Out of the surface of the leaf pours an acid liquid which quickly kills the poor prisoner. The trap remains closed from eight to ten days while the victim is being absorbed, then it opens with its bristles erect and the trap is set once more. The appetite of the plant, however, is not equal to more than two or three of such meals.



S. Leonard Bastin,] [*Bournemouth.*

CALIFORNIAN FLY-CATCHER (DARLINGTONIA).

In Great Britain also we have plants which set these insect traps. The pretty little glistening Sundew (*Drosera*), in the bogs of our moors, is distinctly clever after this fashion. Its leaves, grown in rosettes, are covered with red, pin-like filaments, a drop of sticky liquid topping each. Midges, ants and beetles hover about these attractive plants, and if once they touch a leaf they are glued down while the filaments all round bend over and clutch them. In a couple of days they are dead and digested, and the tentacles straighten out again to catch another unwary victim. Sometimes two or three leaves unite in holding down



[*H. Bastin.*

VENUS FLY TRAP.
The trap open in readiness for a victim.

Another British plant which eats insects is the Butterwort (*Pinguicular*). Out of its pale green shining leaves exudes a sticky substance, and little insects, alighting, get caught in it. The edge of the leaf curls up a little so that they cannot escape and they are soon made an end of. One can often see the remains of these poor victims lying on the leaves.

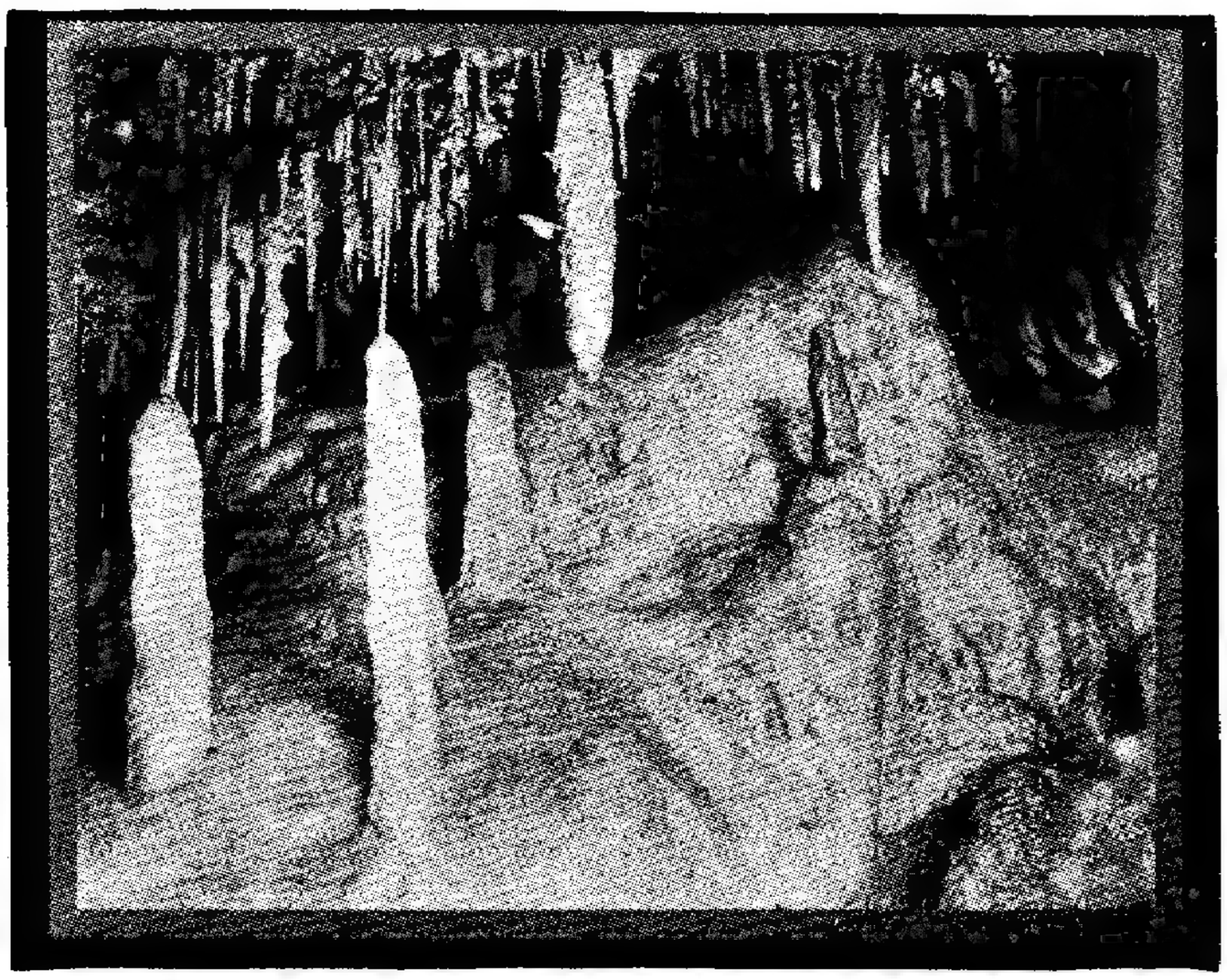
G. CLARKE NUTTALL.

some wretched butterfly or dragon-fly and digest him piecemeal. The curious thing is that if particles of sand or anything similarly indigestible fall on a leaf, though the tentacles may close over it and, as it were, sample it, yet they quickly unclose and make no effort to digest it. The Sundew is really a very "knowing" plant, as the remarkable photographs on page 256 also show.

[*S. Leonard Bastin.*

VENUS FLY TRAP.

A fly captured by the leaf. The "teeth" at the margin are interlocking, and the fly has no chance of escape.



STALACTITES AND STALAGMITES.

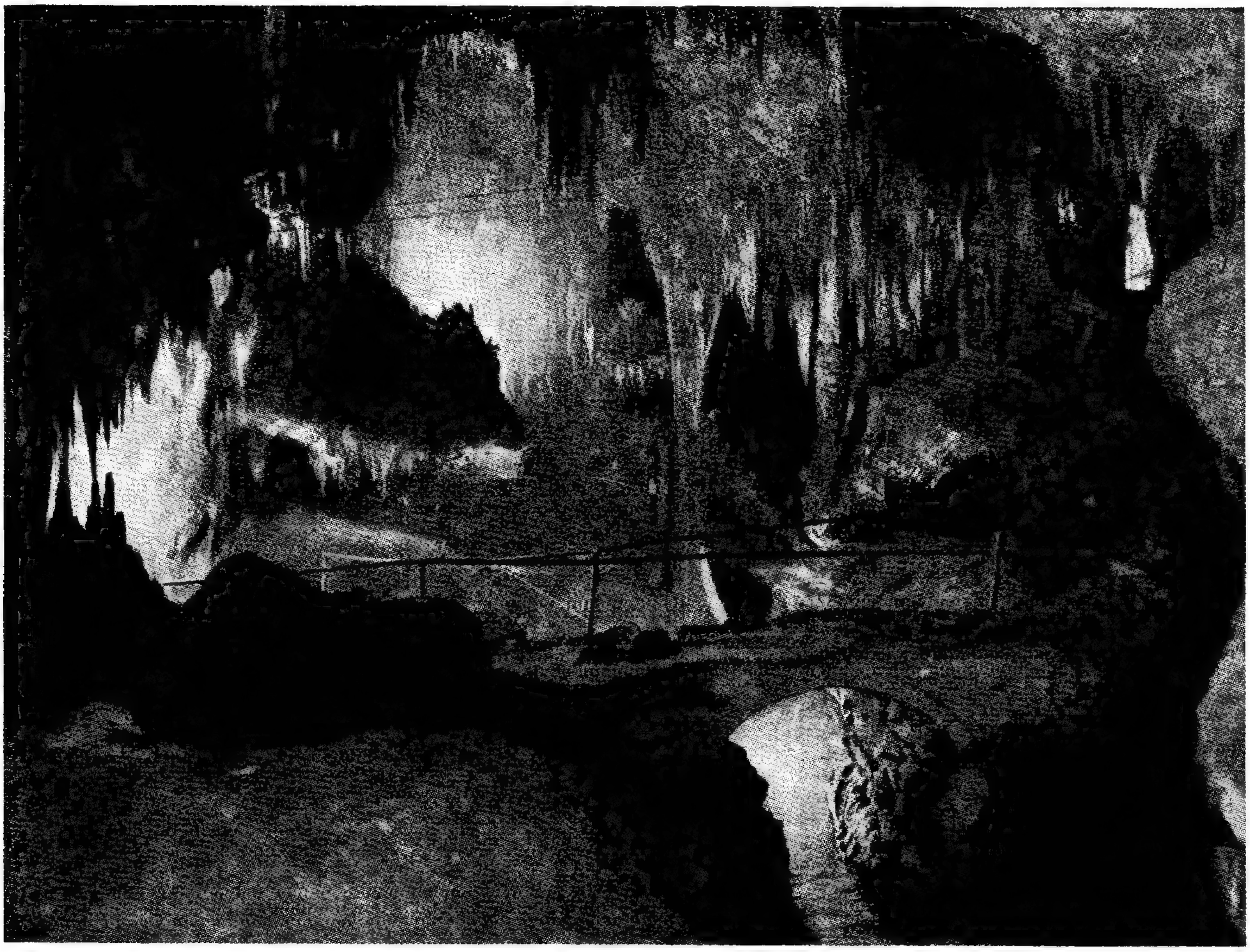
Stalactites are formed by the constant dripping of lime-charged water. At the same time deposits accumulate on the floor of the cavern and are gradually built up as stalagmites. Sometimes stalactite and stalagmite meet and form a solid pillar.

Wonders Underground

THERE is nearly always to boys and girls a weird fascination in the mystery and darkness of a great cave, especially if parts of it are unknown. Many caves, like those of the Cheddar valley and the Peak district of Derbyshire, are natural formations, but some, like those in the chalk at Chislehurst, and in Mexico and other parts, have been quarried out, or enlarged, usually by the men of prehistoric times, who found these sheltered dwellings safer and probably more comfortable than any they could build above ground.

Many of the great caves of the world are beautified by stalactites and stalagmites of rock crystal, which, when light is thrown on them, glitter like great jewels or gigantic icicles. The formation of these wonders of nature is a very slow process; water, charged with the salts of which the crystalline solids are formed, drips from the roof of the cave, and gradually the salts solidify to rock; as the water drips and drips through countless years a tiny stalactite begins to shape, like an icicle in frosty weather, its upper end attached to the roof; at the same time, from the floor of the cave, immediately beneath the stalactite, a stalagmite grows up to meet it, until in the course of centuries a solid pillar is often shaped by the meeting of the stalagmite and the stalactite a little less than half-way from the floor.

When these formations are seen in groups, as in the Luray caverns of



A HALL IN THE LURAY CAVERNS OF VIRGINIA. [E.N.A.

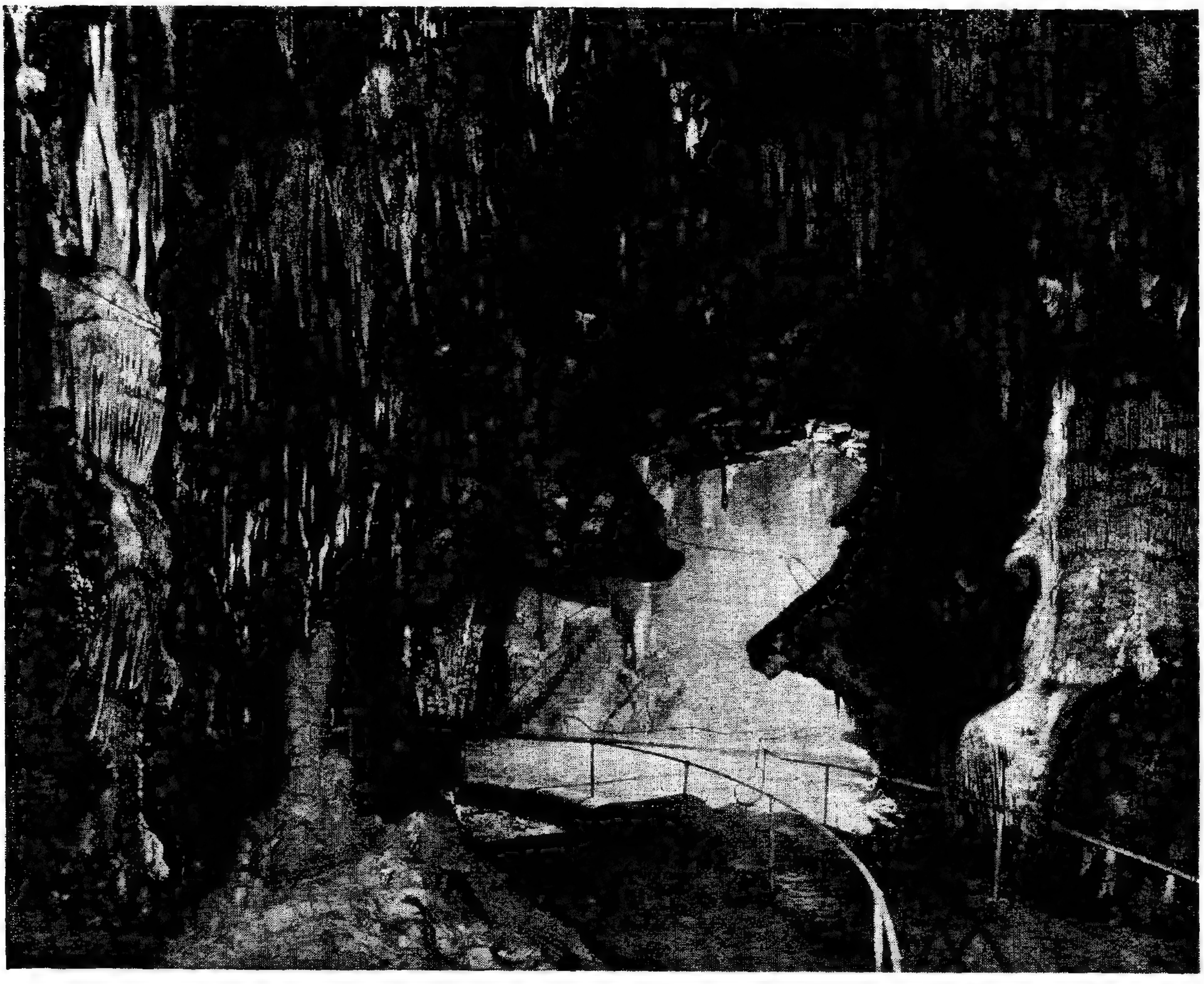
Virginia, the Mammoth cave of Kentucky, and others, the appearance is like that of carved pillars, and the effect is very beautiful. Sometimes, as a stalactite is forming, the water from the roof of the cave will cease to drip in one place and begin in another, producing such remarkable shapes as those shown in our pictures, though as the photographs lack colour they give only a faint impression of the beauty of these underground wonders. Often the designs are so perfect that it is hard to believe that they have not been chiselled out of the rock by human hands. As a rule they are crystalline in character, so that when light is thrown on them their scintillations make the whole cave look like a fairy palace.

The Mammoth cave of Kentucky, generally regarded as the largest in the world, though there may be others far larger yet to be discovered, has never been completely explored. It is possible for people who do not know its depths to lose themselves completely and even to die of hunger and exhaustion before they can be found, since the cave stretches for miles underground. There is a well-known

story of a man imprisoned by accident in one of the great caves of the Mississippi region who found a cup worn in the rock under the point of a stalactite, into which a drop of water fell about once a minute. This was the only place where he could get water, and here he remained until rescued, catching every drop that fell, so that the torture of thirst should not be added to that of hunger.

In the underground rivers which flow in these great caves fish are found that have no eyes; living as they do in eternal darkness, they have no use for organs of sight. Animal inhabitants of the caves, rats and other things, retain their eyes, but they are usually sightless.

The formation of such great caves is frequently the result of volcanic action in past ages; down beneath the crust of the earth great volumes of gas have been generated by intense heat, or steam has been formed by the inrush of water to contact with molten rock, and the pressure of this gas or steam has rent great fissures in the rocks, extending sometimes for miles. In other cases, as in most of the British



[Illustrations Bureau.

IN THE MAMMOTH CAVE OF KENTUCKY.

caves, the flow of water underground has worn caverns by gradually washing away the softer rock between layers of hard material. The same process can be seen going on along many parts of the coast, especially where the waves beat on the foot of a cliff and undercut it to form tidal caverns.

Such giant caves as the Mammoth cave of Kentucky, the Luray caverns of Virginia, and our own Cheddar caves, are much visited by sightseers in these days; guides who know the depths of the caves take parties inside, and show the wonderful formations by means of torches which, when their rays are thrown on the rock-crystal, give the most gorgeous lighting effects. Sometimes electric lights are installed for the purpose.

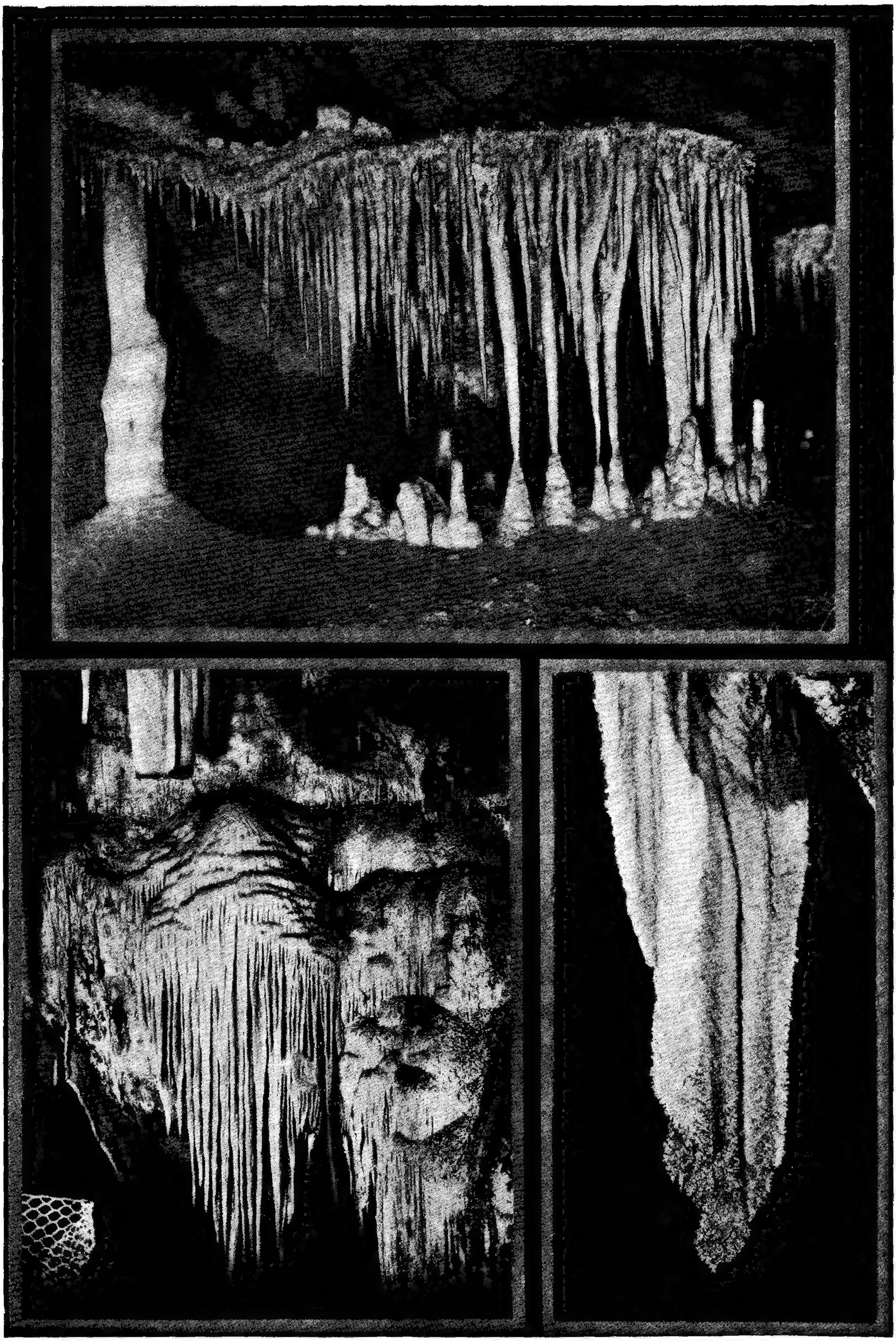
To see the finest and grandest caves in the world we must go to Australia, and thence journey from Sydney by rail into the heart of the Blue Mountains, in the State of New South Wales.

Here are scores of colossal caves, rightly regarded as among the wonders of the world. The best known are the twelve distinct caverns which form the Jenolan group. They contain miles of underground chambers packed with wonderful stalactite creations in the form of columns, domes, pinnacles, minarets, temples, cathedrals, canopies, shawls, draperies, and other objects, so delicately conceived and with such beautiful colouring as to baffle description.

Some of the Jenolan caves are immense—so big, in fact, that you could tuck away in their great hollows a good-sized town. A few of them boast of deep and wide lakes, and others of strange underground rivers upon whose waters ply boats carrying visitors. Many of the caves have only been partially explored, and every year new wonders are being brought to light.

The caves were discovered in 1841, and after a period of neglect were, in 1866, taken over by the Government of New South Wales and declared public property, together with six thousand acres of adjoining land. Here are modern hotels and boarding-houses for the accommodation of tourists, who often go to the caves for a holiday, and spend a week or more exploring them and climbing the mountains.

Of the twelve caves comprising the Jenolan group no two are alike, and each boasts of some distinctive charm or beauty. In the centre of the Arch Cave is a slender column tapering from the roof to the floor. At one time there were five pillars as perfect as that which remains, but in 1860 they were hacked down by someone to place as



STALACTITE FORMATIONS IN THE JENOLAN CAVES. NEW SOUTH WALES.

verandah posts in front of his log hut ! A number of stalactites in this particular cave have been under constant observation for thirty-five years, and the increase in length during that period has been only three-quarters of an inch. The rate of growth of the stalagmite deposits is slower still, probably not more than an inch in 2,000 years. These wonderful columns have taken hundreds of thousands of years to grow !

One of the largest and quaintest stalagmites in the caves is known as the Commonwealth Pillar. Beyond this a snow-white stalagmite and a graceful curtain partially hide from view the Indian Chamber, with a mass of delicate columns and draperies reminding one of a cluster of Hindu temples.

In another cave is a wonderful creation known as Lot's Wife, a remarkable imitation of the Pillar of Salt, while near by is a pure-white stalagmite that looks for all the world like a cockatoo.

In addition to the Jenolan group, there are four other groups equally extensive and beautiful, so that Australia has every reason to be proud of her caves. Not only in number and extent, but in the beauty and gorgeous colouring of their stalactite formations, they easily surpass the caves of any other country.

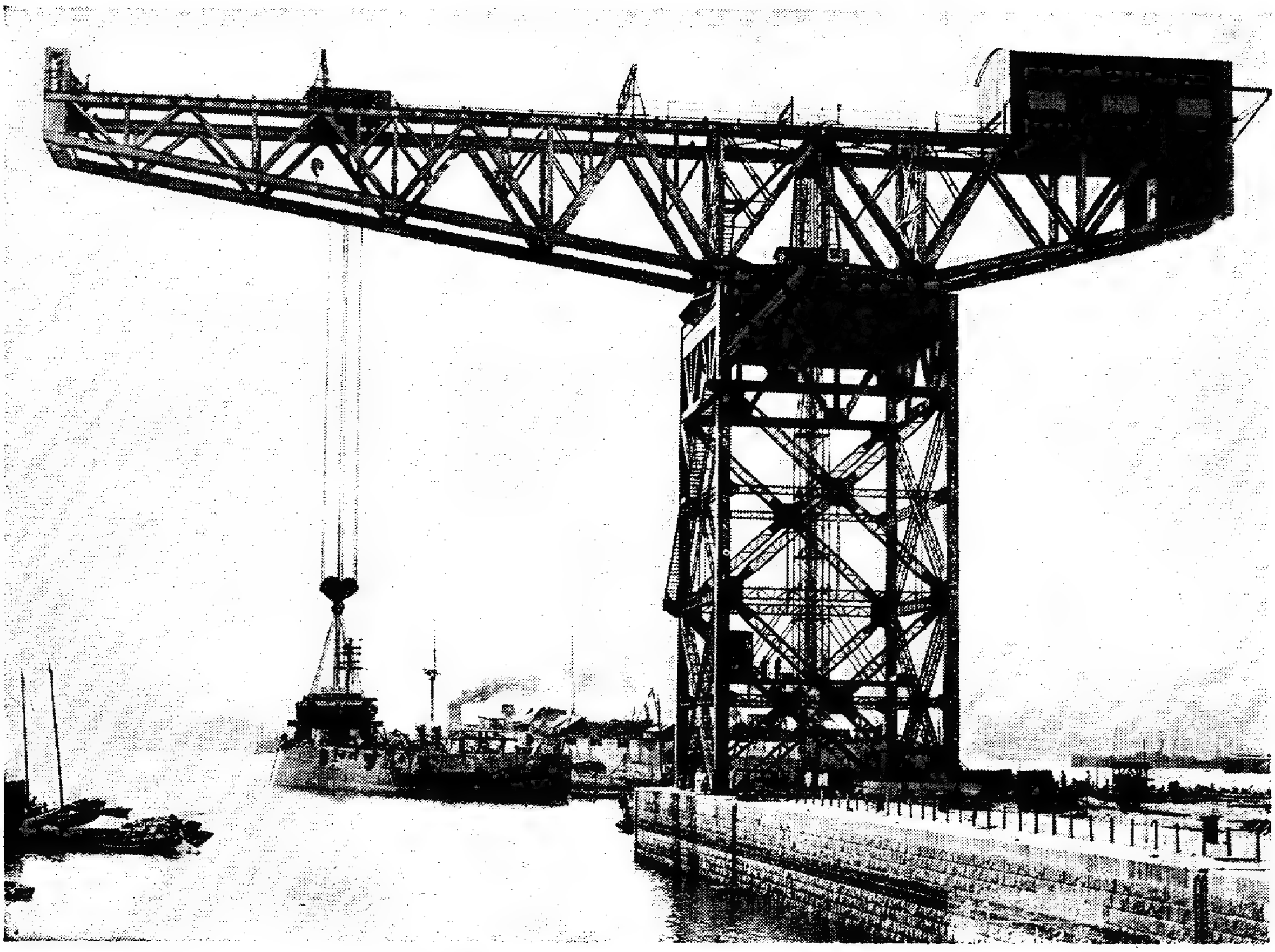
In prehistoric times there were in many parts of the world races of cave-dwelling men. These frequently left traces of their presence in the form of rough paintings on the walls of their homes. The caves of South Africa have pictured walls, as have some in Europe, notably in France, while in many parts of North America the cave-paintings of prehistoric men can still be seen. Cooking utensils, too, and hunting weapons, have been found which prove that some at least of the early races of the world sheltered themselves in caves long before they thought of building huts on the surface.

In those days, when the huge prehistoric animals were the real monarchs of the world, and man was probably hunted as much as he was hunter, a good solid cave formed a very useful dwelling, especially with a rock rolled into the doorway to keep out enemies and wild beasts. But the beasts, too, had their caves ; there was the cave-tiger, far larger than the tiger of to-day, and the cave-bear, another fearsome beast, both of which got their names by living in caves, from which they came out in search of prey. Both these animals have long been extinct, but their skeletons are still found at times in their old homes.

Marvels of Machinery

THIS is often called the "Age of Machinery," but few people, except engineers, realize how truly marvellous is the mechanism that to-day does so much of the world's work.

Some of the most delicately adjusted is that in the great cranes used on buildings and in dockyards. The giant electric crane shown in our photograph will lift a mass two hundred and fifty tons in weight, carry it to the required point, and lower it as gently as if it were a feather; it will pick up a complete ship's engine and drop it in its bed, yet so delicately is it poised that it would set a glass of water on a table without spilling a drop. Three separate electric motors do the work of this crane; one is concerned solely with lifting and lowering; the second runs the lifting carriage backward and forward along the framework; the third slews the great arm around to the point where a load is to be picked up or lowered. There is another



[*Special Press.*

A 250-TON ELECTRIC CANTILEVER CRANE.

The crane has three separate motions, main lifting, for loads up to 250 tons; auxiliary lifting, for loads up to 30 tons; and slewing and traversing gear.

[*Illustrations Bureau.*

A WONDERFUL CRANE.

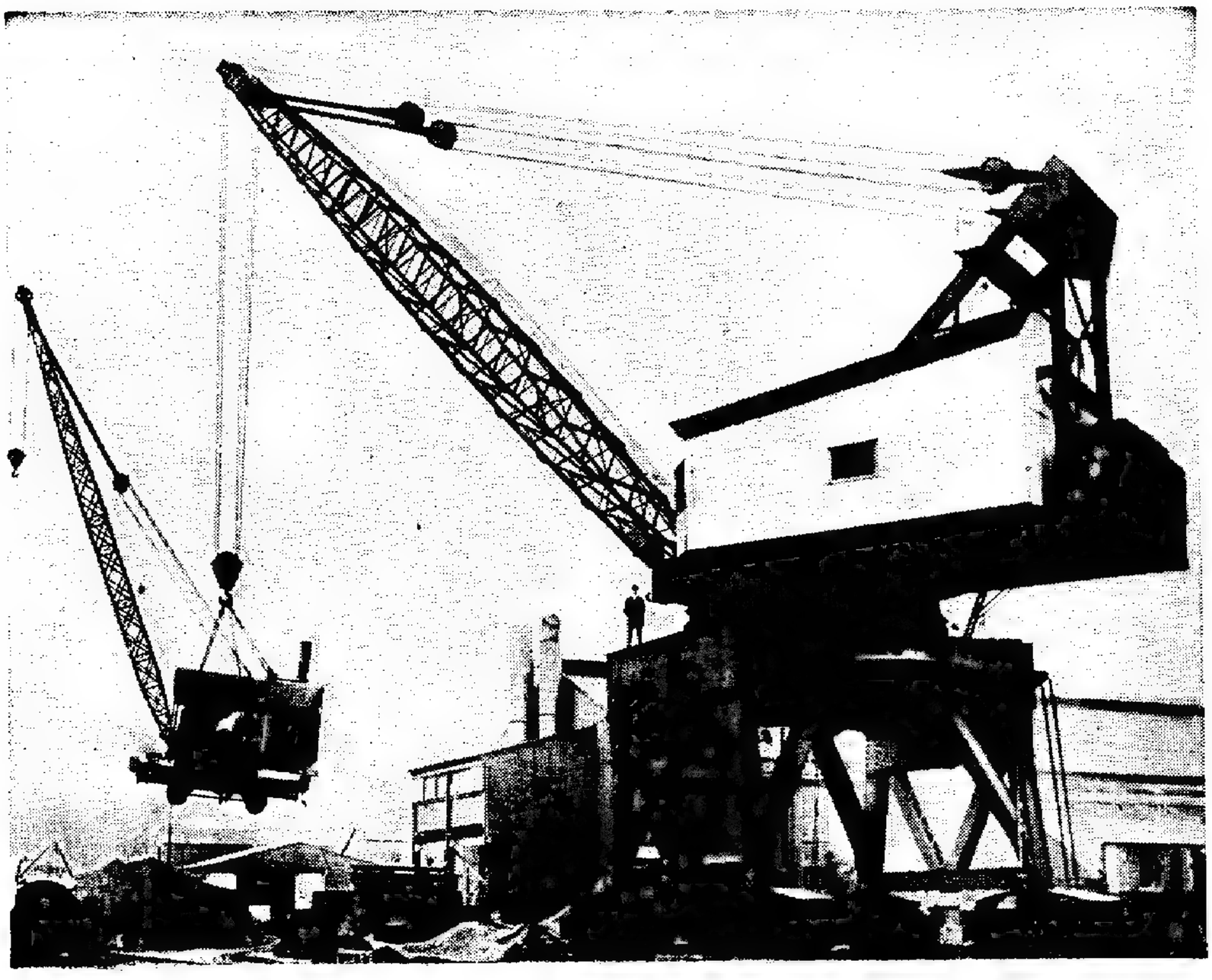
The Mitchell appliance (British) lifts a loaded coal truck from the railway and empties it, and at the same time weighs the coal.

gravel, and swing them into place, or handle great steel girders as if they were lead pencils. A great deal of clever work has gone to the designing of cranes.

But, impressive as they are by their strength, cranes ar comparatively simple. Harvesting machinery is not so. In place of the old sickle and flail, taking months to get the corn from field to

motor, auxiliary to the main three, for dealing with trifles not more than thirty tons in weight.

The Mitchell tipping crane, an all-British invention, picks up railway trucks bodily from the line, tilts and empties them, then straightens them out and replaces them on the rails, ready to fetch another load. When you know that the load in a railway truck is somewhere about ten tons you realize that this tipping crane is no weakling. Then there are the three-legged giant cranes used in building, which pick up loads of bricks or



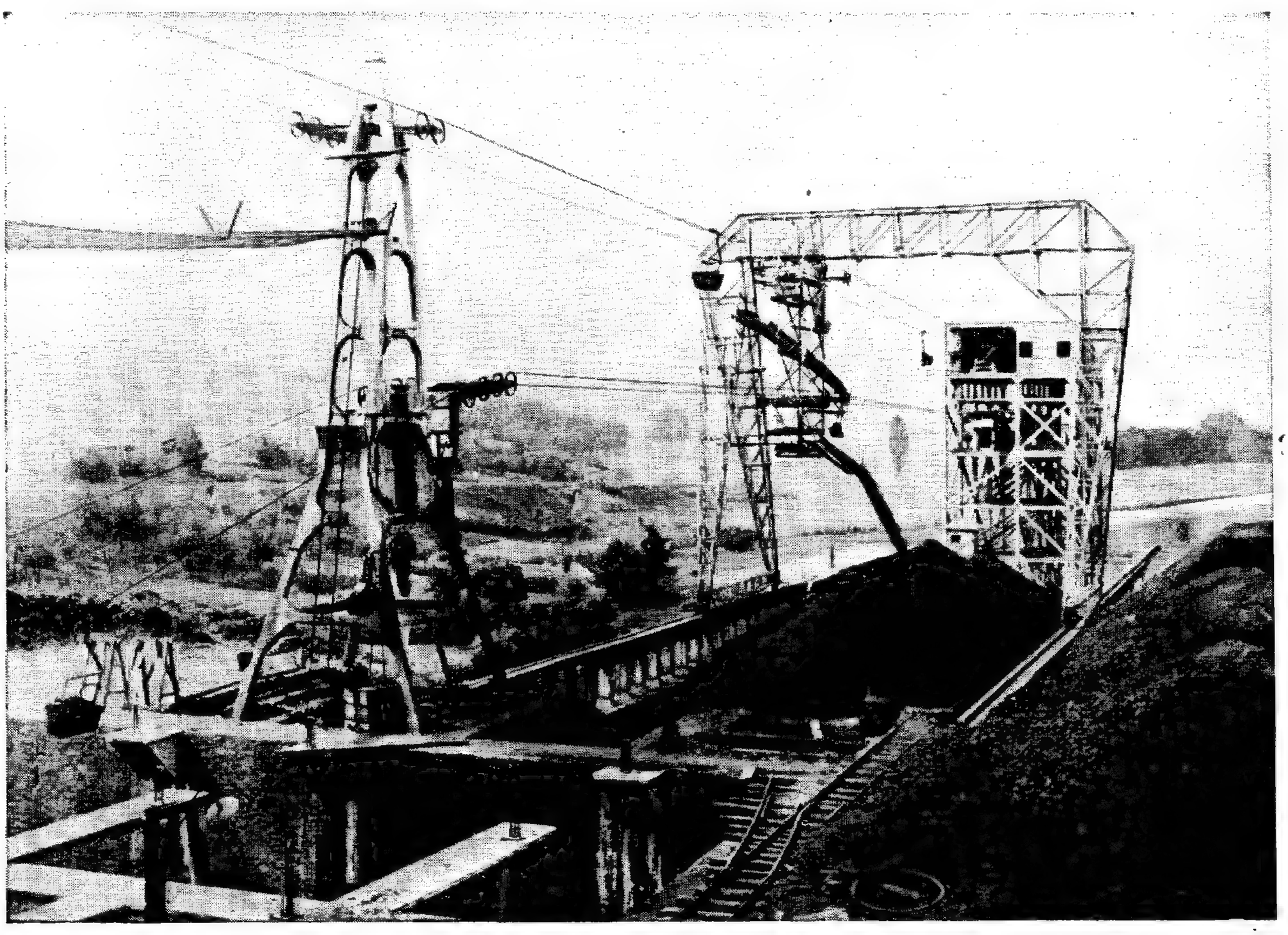
[*Fleet Agency.*

A CRANE THAT EASILY LIFTS ITS LITTLE BROTHER.

A 25-ton electric travelling crane, belonging to the Port of London Authority.

mill, there is the harvesting thresher, which reaps the corn, threshes the grain from the ear as it travels, puts it into sacks and keeps up its own supply of steam by using the straw to feed its furnace. Instead of a host of labourers, all that is required is a lorry to come round the field and pick up the sacks of grain, and take them to the grain elevator for shipment, or straight to the mill for grinding.

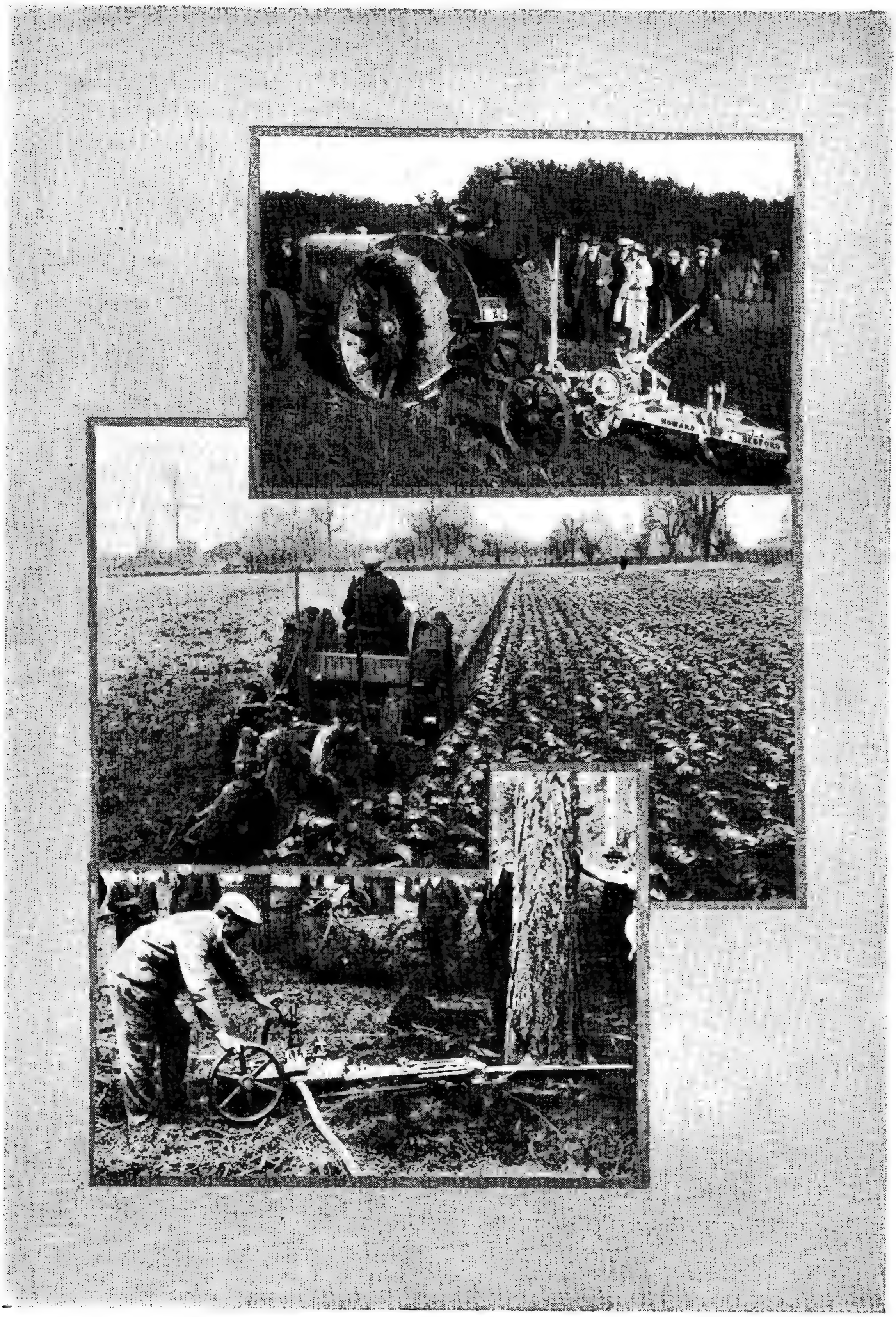
Digging machinery, again, has been so perfected that one machine with a couple of attendants to guide and feed it will do the work of



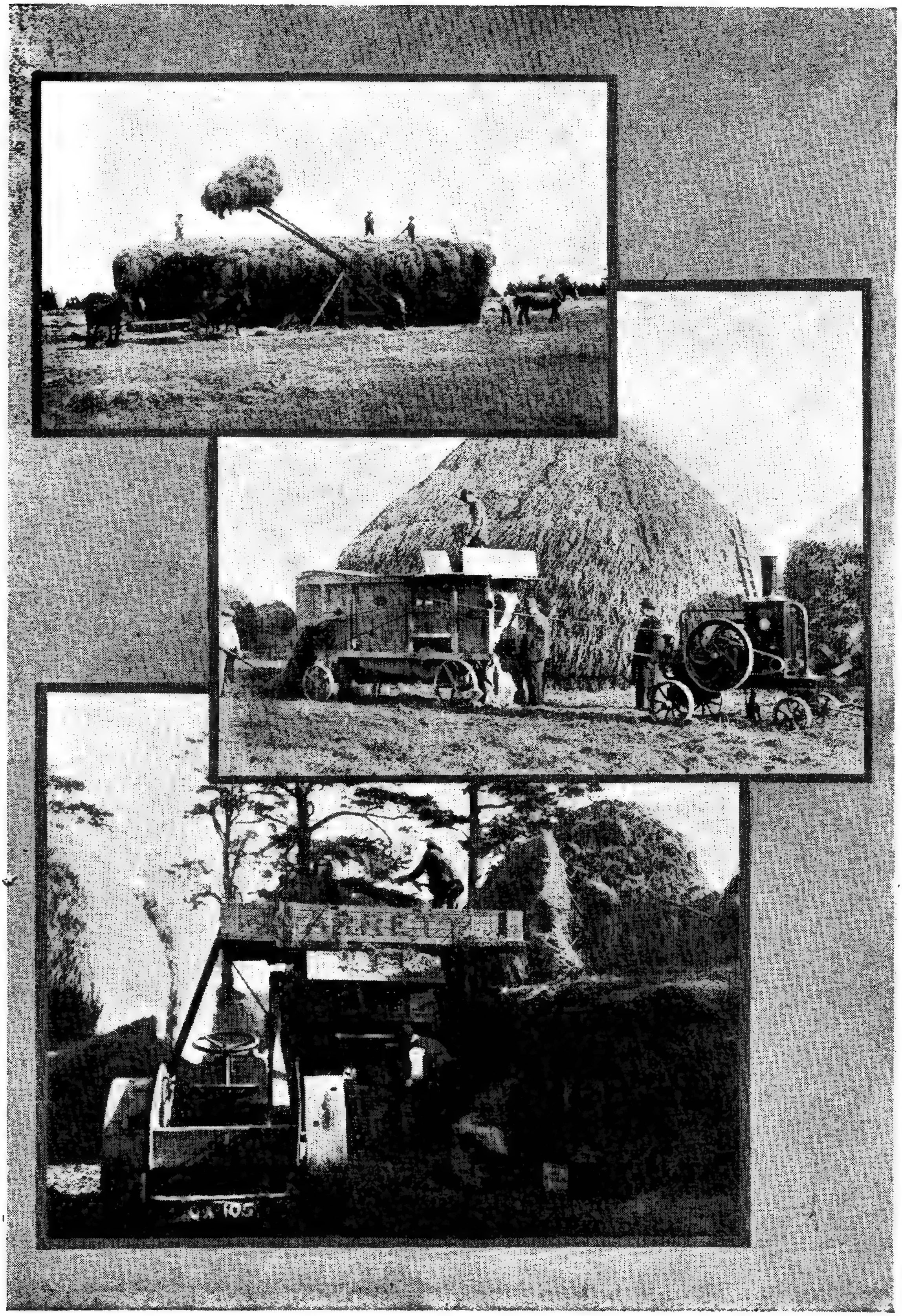
[Fleet Agency.

AN AERIAL ROPEWAY ON WHICH THE BUCKETS EMPTY THEMSELVES AND RETURN TO BE LOADED.

nearly a hundred men. There is a trenching machine that will cut a ditch nearly 5 feet deep, $2\frac{1}{2}$ feet in width at the top and a foot in width at the bottom, travelling nearly as fast as a man can walk, and throwing out the earth to one side far more neatly than can men with shovels. Then there are "steam navvies," which carry something like a gigantic coal scuttle at the end of a crane-like arm. The coal scuttle appliance takes a "bite," lifts the earth and drops it into a cart, and one and a half tons of soil have been shifted! It would



MACHINES THAT HELP THE FARMER.



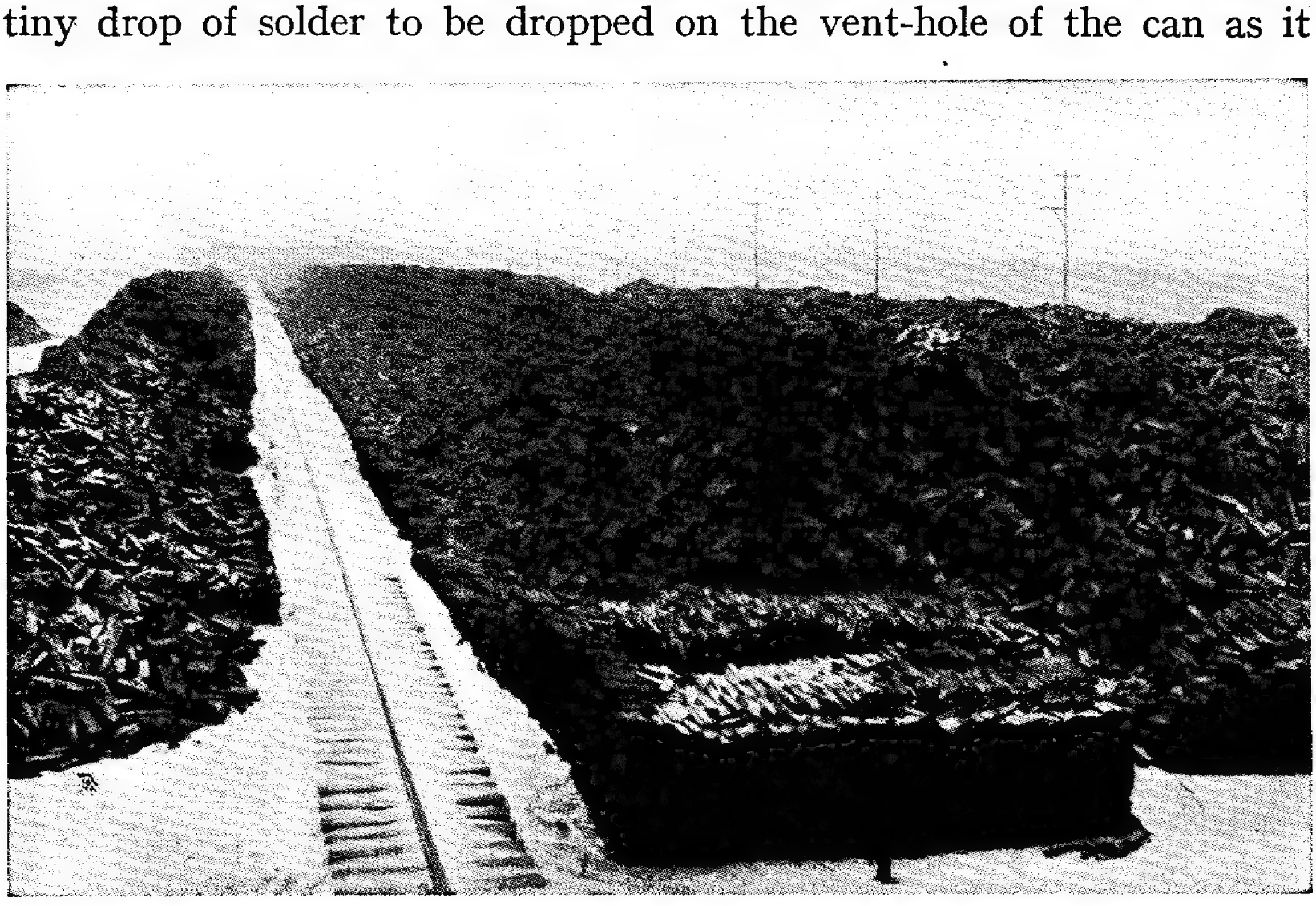
[*Photos reproduced by courtesy of New Zealand Government, the Austin Motor Co., and the Agricultural General Engineering Co.*

MACHINES THAT HELP THE FARMER.

take many men with shovels a long time to do the work that this machine accomplishes in a minute. In the iron-ore district of Pennsylvania they even have an electric shovel that will take *twelve tons* of earth at one bite, lasting only from 40 to 45 seconds. These giant shovels will in an eight-hour day shift 4,500 tons of earth.

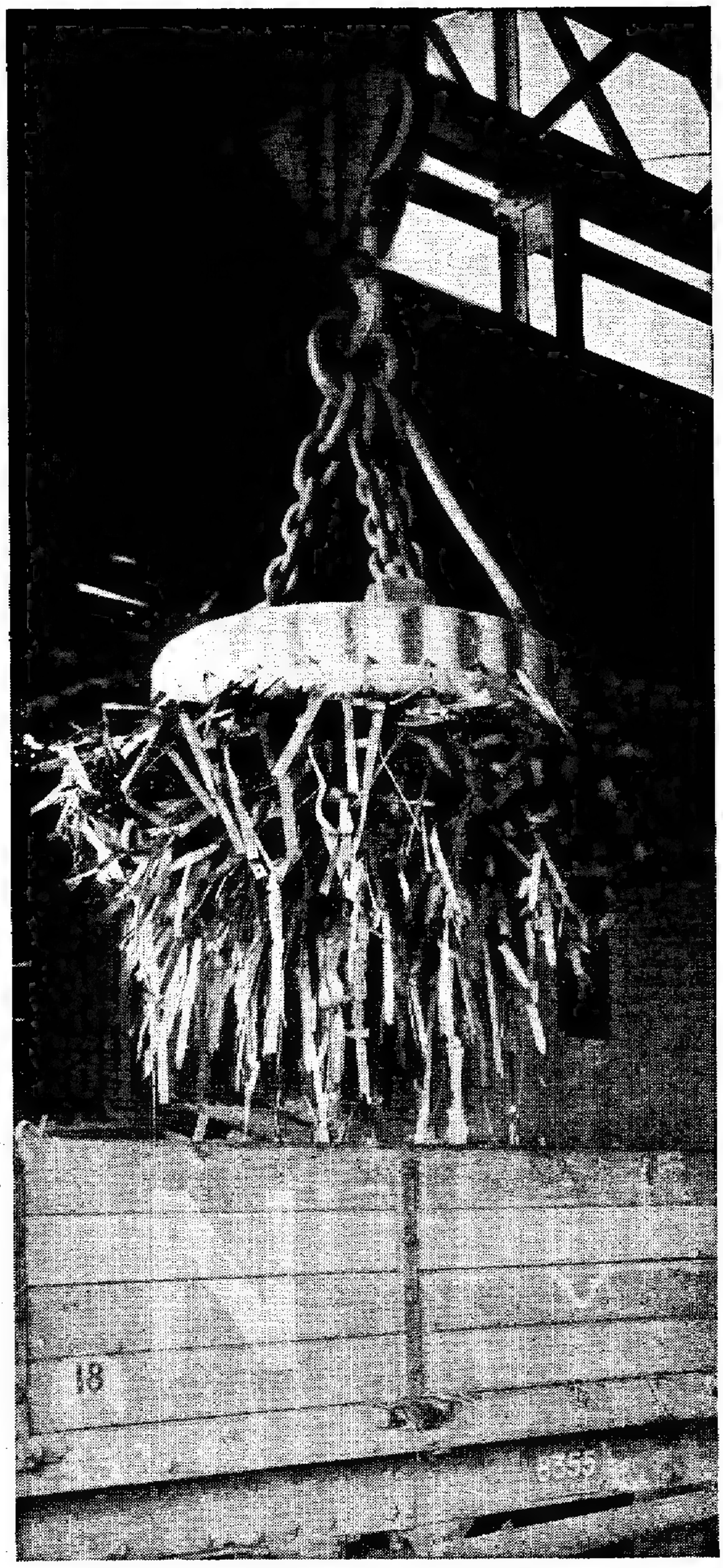
In food-preparing machinery, again, there are some wonderful devices. In some of the great Chicago factories the carcase of a pig is taken charge of by a machine which scalds and removes the bristles in one section, cuts up the carcase in the next, divides the meat from the bones, grinds it up, prepares sausage skins, and turns out sausages ready for cooking, while the bones and bristles are carefully collected —all by machinery—for their separate uses. It has been said that if the sausages are not up to standard, they are put back and the machine reversed, when the pig walks out at the other end again, but that would be straining even an American machine too far.

Of somewhat similar nature is the machinery used in the Alaskan fish canneries. The salmon are gutted by hand, but the rest of the work is done by machinery. The cut section of fish is deposited in the tin, boiled and the tin soldered, and then nothing remains but for a tiny drop of solder to be dropped on the vent-hole of the can as it



[*E.N.A.*

A QUARTER OF A MILLION TONS OF PIG-IRON ABOUT TO BE HANDLED BY AN ELECTRO-MAGNETIC CRANE.



[*Central Press.*

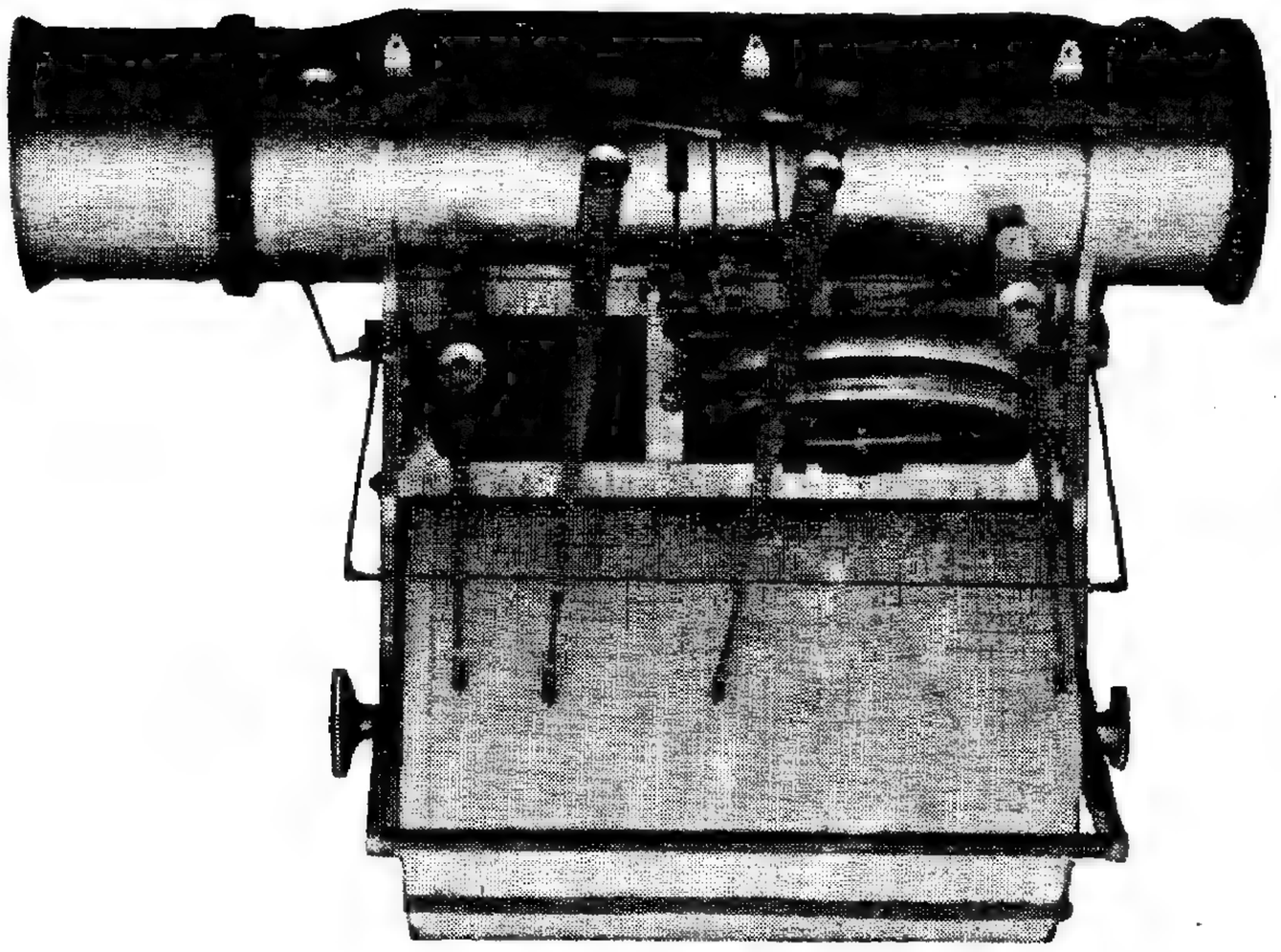
A LIFTING MAGNET EMPTYING A TRUCK-LOAD OF IRON SCRAP.

One of these magnets will do the work of several men with barrows. A magnet, too, can deal with iron when it is far too hot for men to handle.

comes out, ready to be passed to the machine which, after cooling, attends to the labelling. The tin then goes into a case made by machinery.

Very different, but of perhaps even greater interest, are some of the ingenious appliances used for scientific purposes. The meteorograph, sent aloft on a kite, brings back records of what the weather is like at heights where no man can go, writing down temperature, amount of moisture, and direction of air currents for those who sent it up to read when it is hauled down. Even the vibration caused to buildings on omnibus routes is used as a weather indicator, an instrument having been designed to tell by the intensity of vibration whether wet weather is approaching. This, like the meteorograph, is an electrical device. Indeed, the uses of electricity, apart from ordinary lighting and heating, are numberless. It can be made to lift heavy bars of pig-iron and also adapted to extracting particles of iron and steel from the human eye and body, thus saving complicated operations. It will do all the rough work of our houses and at the same time can be used to make stop-watches register to the hundredth part of a second—no human hand could possibly actuate a stop-watch so accurately.

It is interesting to watch an electro-magnetic crane loading a truck. The lifting arm goes out over the pile, the cable drops the magnet down into contact with the " pig," a little lever is moved, and



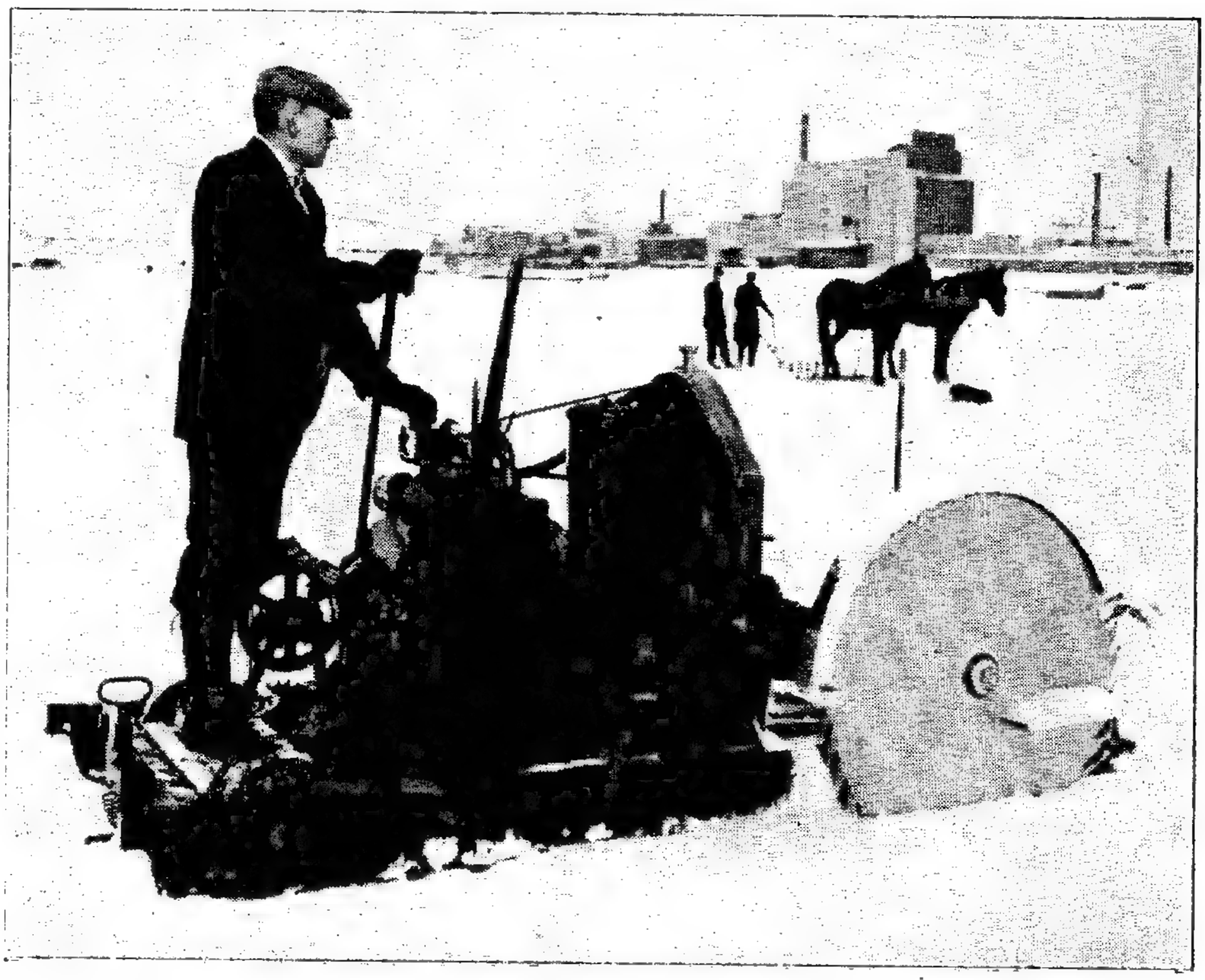
[*Press Exclusives.*

THE METEOROGRAPH.

This wonderful little instrument "explores" the upper regions of the air, being attached to kites to ascertain the humidity and temperature of the atmosphere and the direction and force of air currents.

the inert magnet takes to itself invisible power as great as that of steel grappling hooks. Then the cable pulls up the magnet and its tons of adhering "pigs," the arms swing round, the magnet is let down into the truck, the current is switched off and the invisible hold released. Trucks are loaded to exact quantities, and the finishing process reminds one of the grocer weighing out a bag of sugar. The man at the scales calls out "One thousand short." The craneman thereupon cuts off a tiny bit of current and a corresponding number of "pigs" drop into the truck. Now there is slightly too much, and the craneman adds more "juice" to the magnet, which picks up a pig or two, and the scales balance.

There is a machine which cuts out twenty suits of clothing at one operation, linings and all, ready for the material to be passed on to other machines, which make up the suits and turn them out finished to the last buttonhole. Similarly there are machines which cut the uppers of a pair of boots in one operation, and the



[*Fleet Agency.*

A TRACTOR ICE SAW.

This machine, which works both backward and forward, will cut 30,000 cakes of ice a day. It does the work of sixteen men and eight teams of horses.

[*E.N.A.*

A GIANT REAPING AND BINDING MACHINE, ALBERTA.

soles and welts in another, placing them ready for stitching together by a third machine which turns out the finished boots. It may be said, in fact, that there is a machine for nearly every task, saving the labour of many more men than are required in minding mechanism, and thus making it possible for one man to do the work of ten or twenty in less than half the time. And this is all for the good of the world, for it is a true saying that "work makes work." Every labour-saving device tends in the long run to make goods cheaper, and if goods are cheaper more people can afford to have them, and more are required, and so, as has been proved again and again, more work is found both for machines and men. E. C. V.

[*E.N.A.*

FIGHTING INSECTS BY AEROPLANE.

An aeroplane scattering a cloud of poison powder to destroy insect pests.

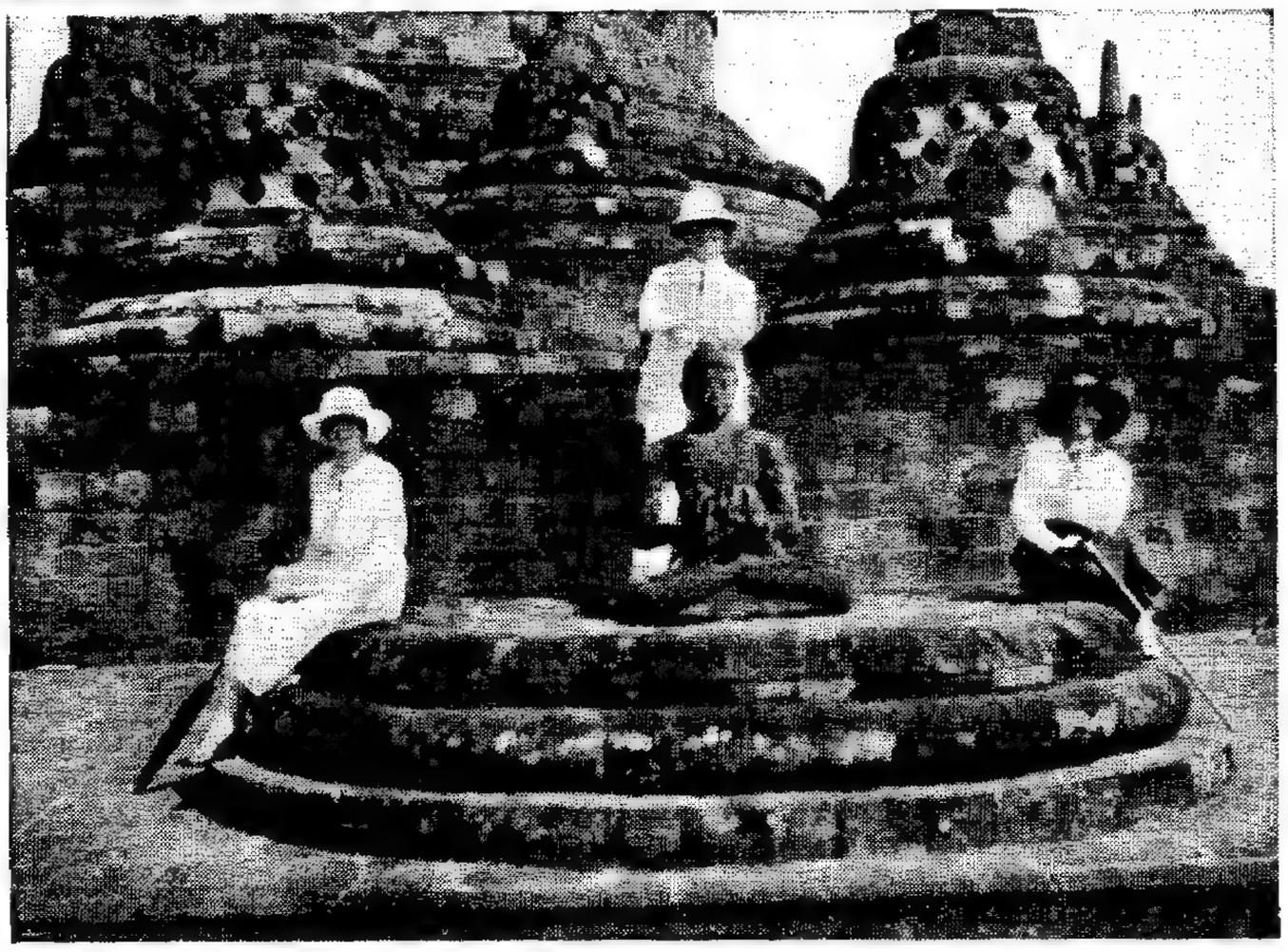
The Wonder Temple of Java

THOUGH never quite completed, the Boro-Bodoer, in Java, ranks among the wonder-buildings of the world. It is really a hillock covered with a series of terraces decorated by thousands of statues, until the result resembles a richly-iced cake. Around the topmost

[*Underwood & Underwood.*

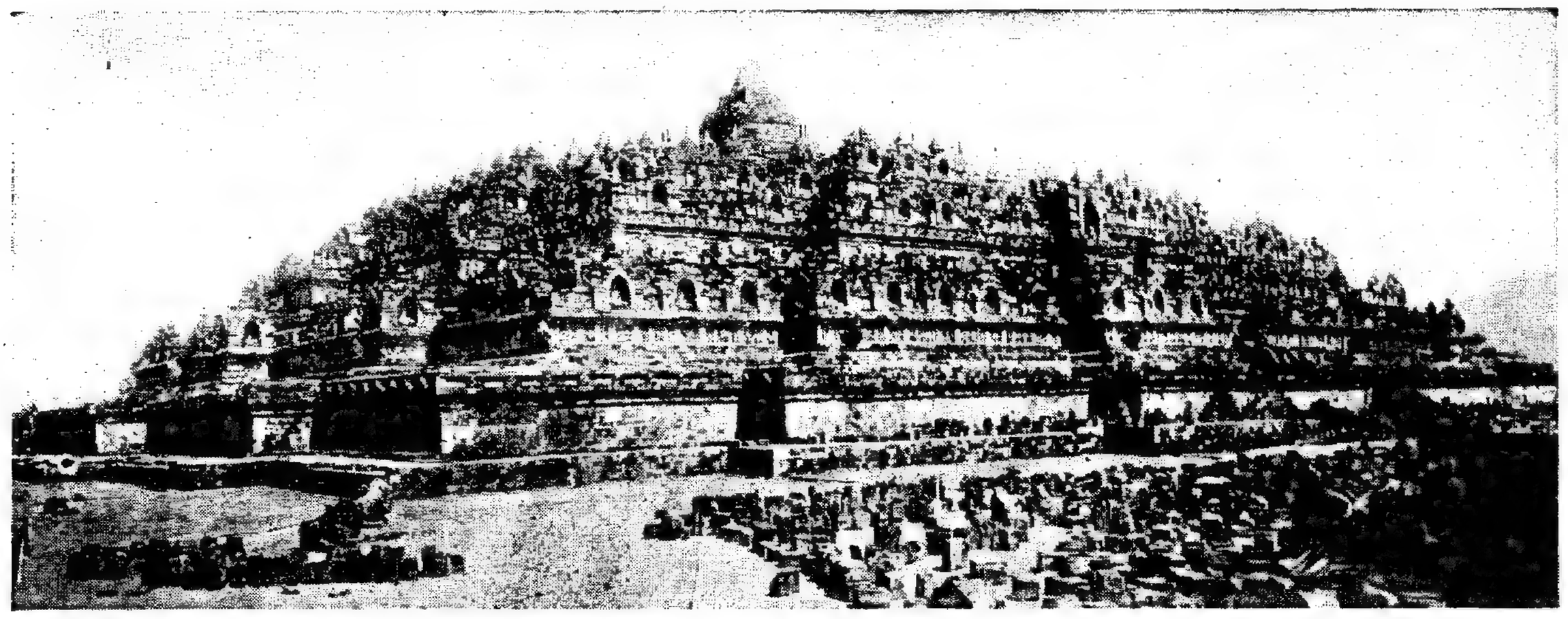
TWO OF THE LATTICED DAGOBAS.
In each "bell" is a figure of Buddha.

temple are seventy-two bell-like cupolas covering seated figures of Buddha. It is estimated that there are three miles of carving. Large as the temple is it was buried in jungle growth for centuries and only brought to light about a hundred years ago.



[*Special Press.*

A "bell" removed, showing the seated Buddha beneath.



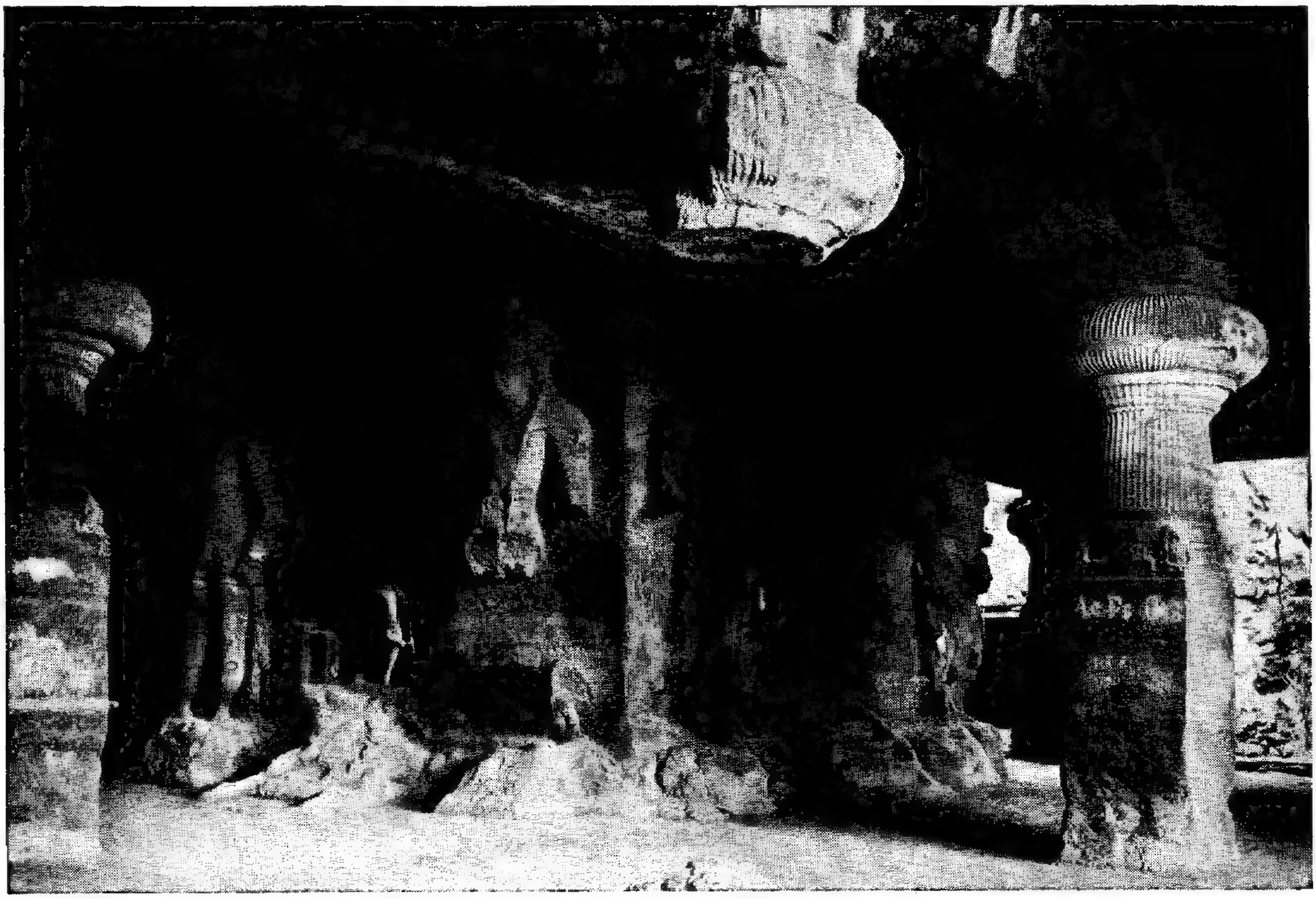
[*Special Press.*

THE TEMPLE OF BORO-BODOER, JAVA.

Some Wonders of Ancient India

THERE are few British boys and girls who have not at some time longed to see something of the wonderful land of India, of which they read so much during the recent visit of the Prince of Wales.

That great country—or perhaps we should say continent—is by no means the only one in which almost side by side with the most modern buildings there are to be found relics of a past that goes back



[*E.N.A.*

THE ROCK CAVES OF ELEPHANTA, BOMBAY.

Hewn out of hard trap-rock, probably in the ninth century, and containing many sculptured figures and carved columns.

to the very dawn of history. But there are few, if any, places in the world where in the course of a few days' journeying you can see such a variety of "antiquities" and, what is still more surprising, surviving and not much altered types of the actual races of whose craftsmanship those "antiquities" are examples. You would think it strange if within easy distance of Stonehenge you came across a village inhabited by ancient Britons and looking much as it might have looked 2,000 years ago. But in India there are plenty of little hamlets in which

most, if not all, the tenants of the mud huts live and work and think exactly as those lived and worked and thought who made the wonder-buildings pictured in this article. As a matter of fact, if you dive into the forests of Central India, or climb the higher wooded slopes of the Himalayas, you come across tribes that are descended and differ very little from the very earliest of settlers in India, who left little behind them except some strange and barbarous customs—human sacrifice among them—and languages which are now beginning to disappear.

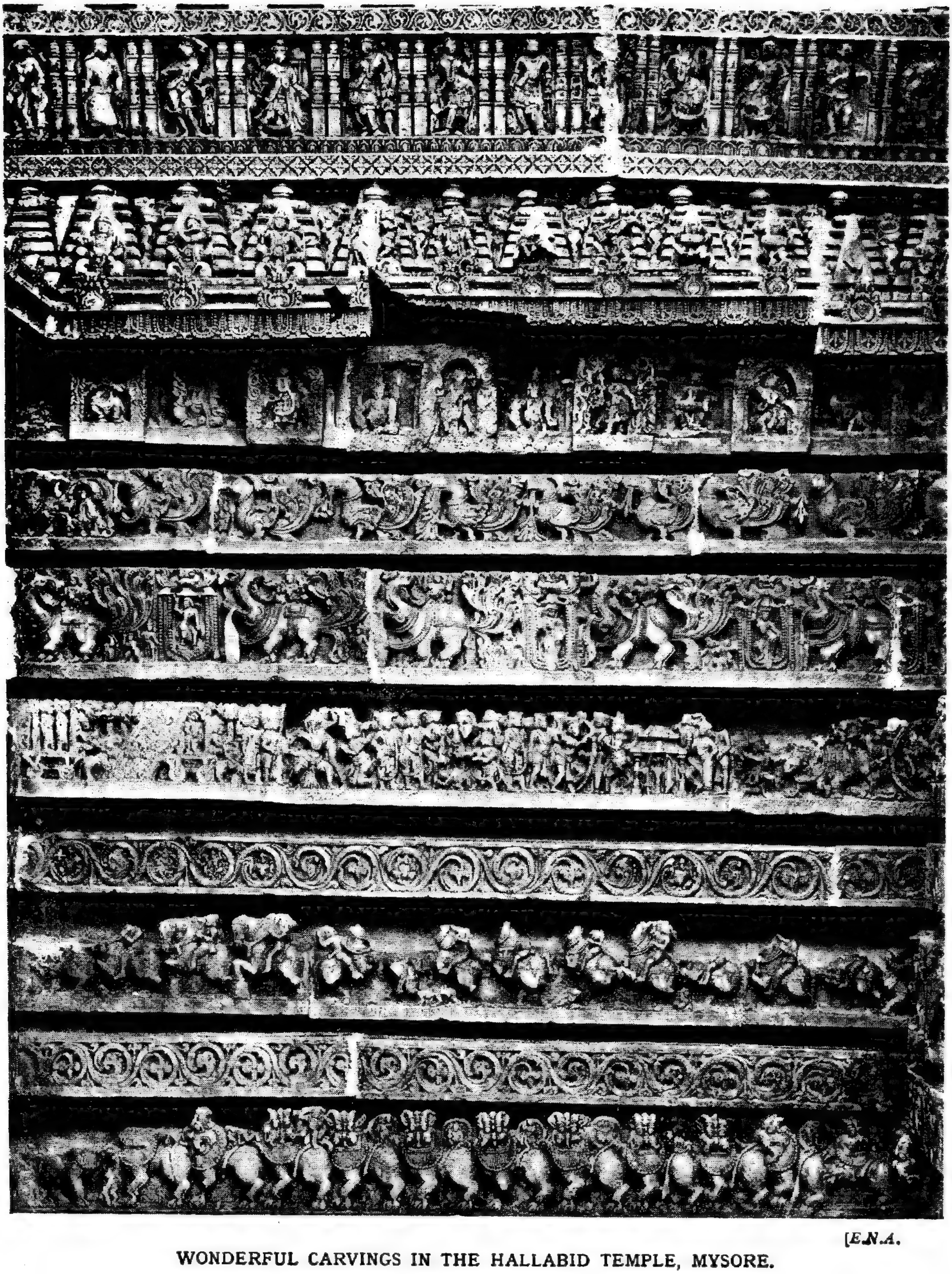
Building began in India when the fair-skinned Aryans streamed through the north-western passes of the Himalayas and drove the dark-skinned early settlers before them into the hills and to the south. This may have happened over 4,000 years ago, but at first the buildings were of wood, and it was not until about the third century before Christ that stone was used for the more important buildings. By that time the religion known as Buddhism had spread over Northern India, and among the ancient structures which represent this period is the great quaintly-shaped Buddhist Sanchi Tope, near Bhopal. These "topes" were simply great memorial mounds heaped up over the body of some famous person, and shaped like drums with domes on the top of them. Round them ran a massive stone railing with gates on four sides, and the ornamentation on some of the gateways, that at Sanchi, for instance, is very elaborate. Of about the same age as the topes are the rock-cut Buddhist temples and monasteries, and some beautiful temples built by the Jains, a sect which came into existence, like the Buddhists, about 500 B.C. and still lingers in Upper India.

[*Bourne & Shepherd.*

THE JAMA MUSJID, DELHI.

In this famous building is the beautiful Hall of Audience shown on page 207.

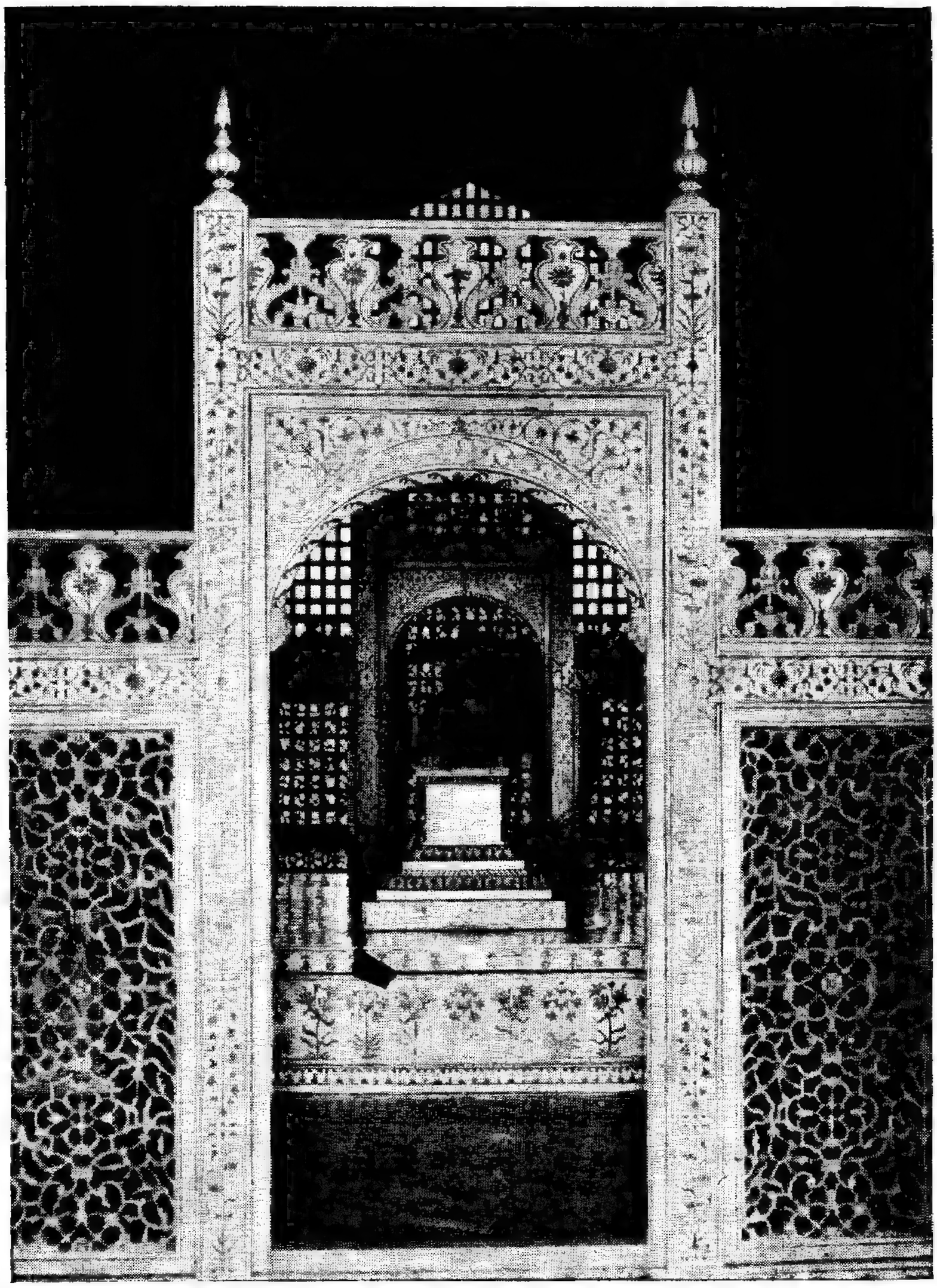
Buddhism in India gradually gave place to Brahmanism and, though the two religions flourished together for more than a thousand



[*E.N.A.*

WONDERFUL CARVINGS IN THE HALLABID TEMPLE, MYSORE.

years, Buddhism, about the time of the Norman Conquest of England, was beginning to die out. Like the Buddhists, the Brahmans had rock-cut temples, some famous examples of which are to be found on the island of Elephanta, in the harbour of Bombay. These caves are believed to date from the ninth century, and the most important of them, the Great Temple, is still used by Hindus at one of their festivals. It is entirely hewn out of the hard rock, measures over 30 yards square, and is filled with columns and sculptures. One of the latter is a bust of the Hindu god of Destruction, Siva, which is nearly 18 feet high.



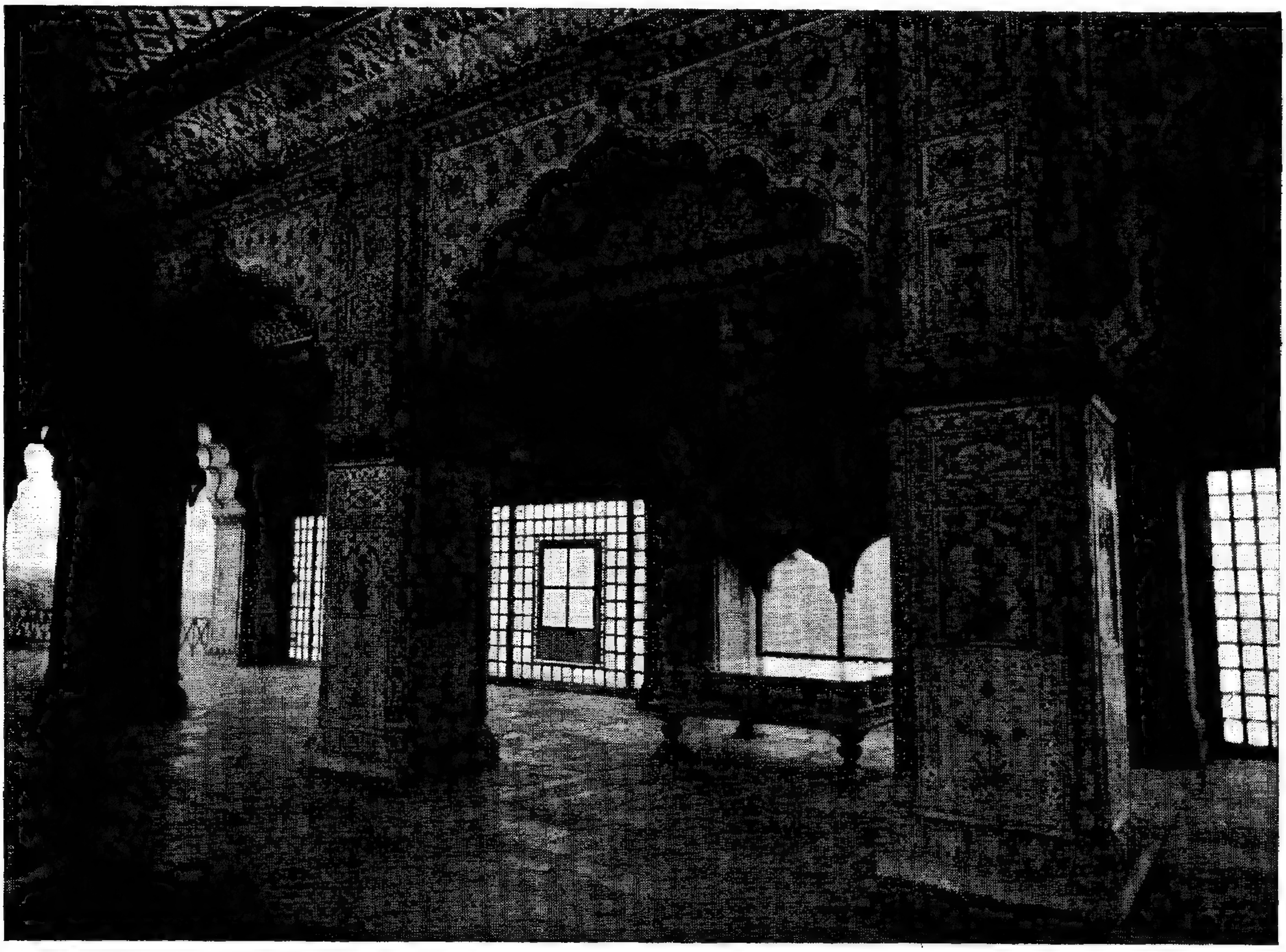
[*Underwood & Underwood.*

THE BEAUTIFUL MARBLE SCREEN IN THE TAJ MAHAL, AGRA.

While the earliest settlers in India left no buildings behind them, the successors of those whom the Aryans drove before them into Southern India made some very wonderful temples. Some are Buddhist, some Brahman, and some Jain, but they are quite unlike those which Buddhists, Brahmans and Jains built in Northern India, and belong to what is called the Dravidian style of architecture. One of the most remarkable of them is the Hindu temple called the Kailas and dedicated to Siva, at Ellora, in the dominions of the Nizam of Hyderabad. This architectural wonder was simply hewn out of

the solid granite of the hills. First a great square was marked out, and along the four sides a deep trench was sunk. This left a huge mass of stone in the centre, which was then cut and carved into a temple, with courts and colonnades, obelisks, and sculptured figures, some of the figures being from 10 to 12 feet high.

The Ellora caves are said to date from the seventh century, in which Christianity obtained a foothold in England. There were some



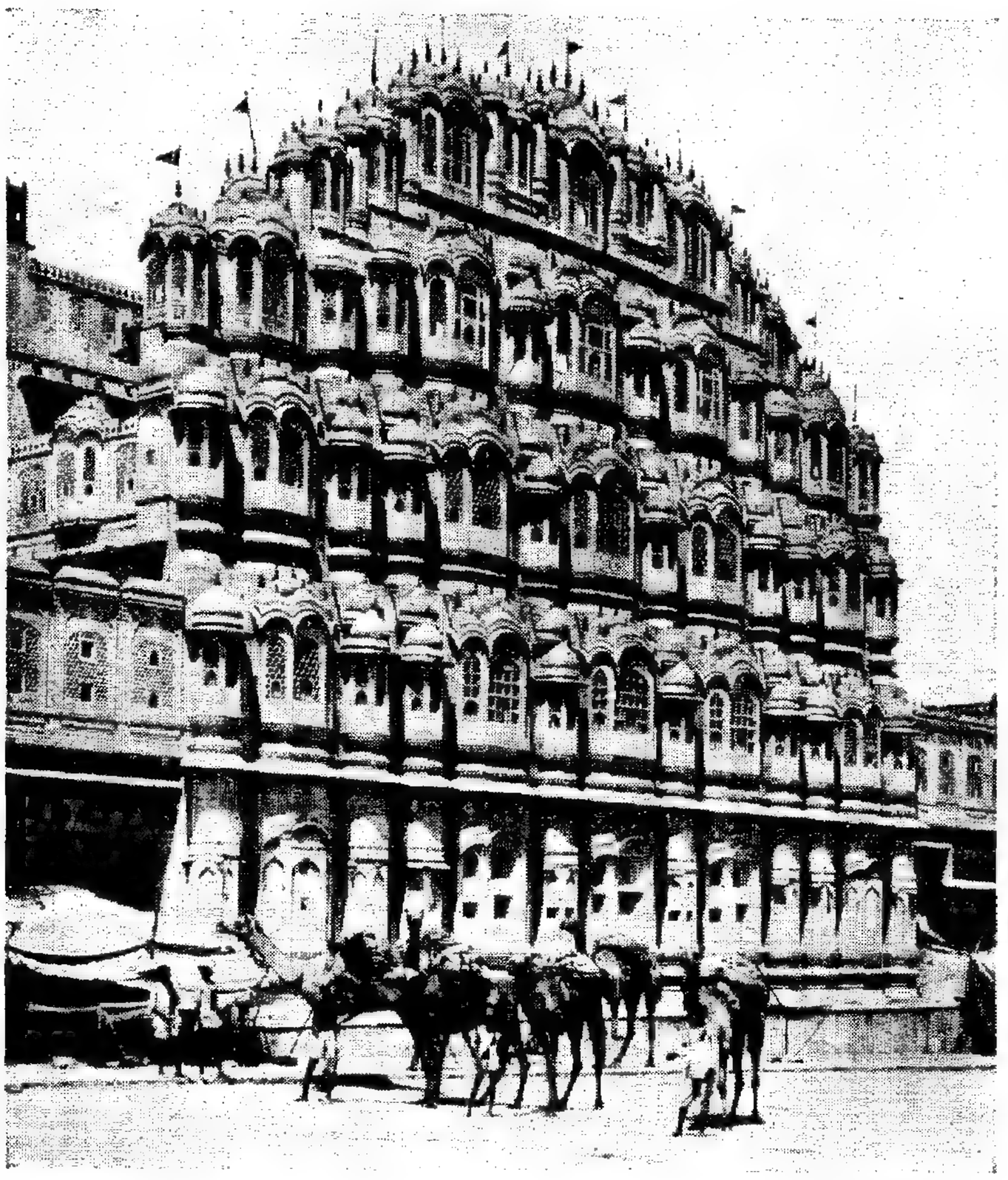
(E.N.A.

HALL OF AUDIENCE, DELHI.

Like the beautiful Taj Mahal, this was built by Shah Jehan. It bears the inscription, "If there is a heaven on earth, it is this—it is this!"

Christian Abbeys in Europe in those days, but our own Westminster Abbey was not built until the thirteenth century, and, even if the old Church which preceded it before the Conquest were still standing, it would be three centuries younger than the marvellous rock-cut temples at Ellora.

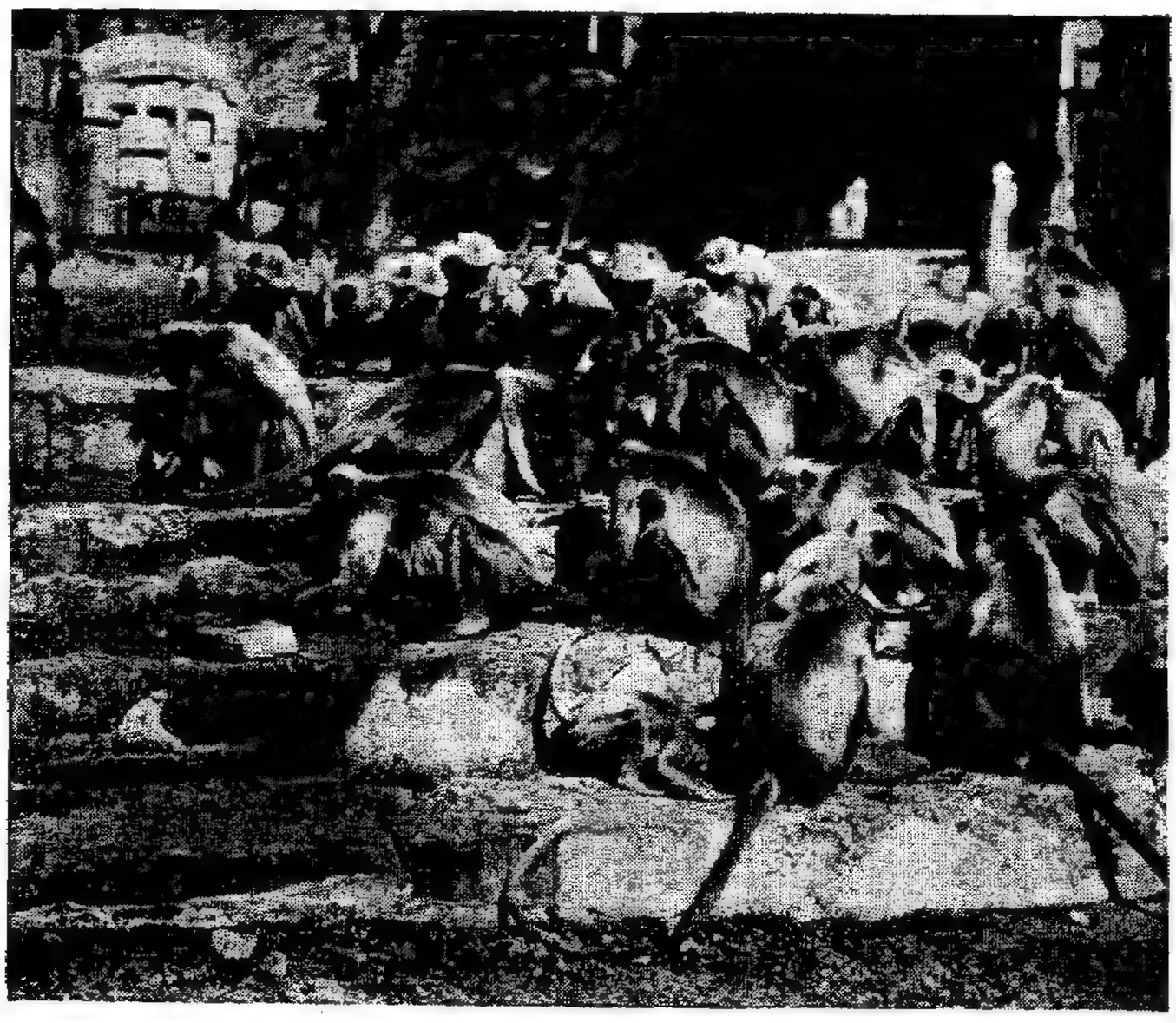
While Westminster Abbey, as we now see it, was being built, the Mohammedans began to invade India, and from the fifteenth century to the middle of the eighteenth, when the British began to get the upper



[E.N.A.

HALL OF THE WINDS, JEYPORE.

hand, the greater part of the country was under Mohammedan rule. In 1525–26, while our Henry VIII was still on the throne, a Central Asian chieftain named Baber crossed the river Indus, occupied Delhi and Agra, and founded the famous Moghul Empire, of which hundreds of noble monuments remain in India to this day. Of these perhaps the most notable, and certainly the most beautiful, is the famous Taj Mahal, a mausoleum built by the Moghul Emperor, Shah Jehan, in honour of his favourite wife, Mumtaz Mahal. This lovely building is at Agra, and the exquisite grace of its design, and the richness and delicacy of its construction, have been the theme of glowing descriptions by writers of all countries. Seen best by moonlight, when the dazzling whiteness of its exterior is subdued into dreamy softness, it is always a sight to be remembered. It stands in a garden, and has lofty pavilions and arched ways, walls inlaid with stones of various colours to represent birds and flowers, and marble gates perforated so



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MONKEYS APPARENTLY IN ATTITUDES OF DEVOTION ON THE STEPS OF A TEMPLE AT JEYPORE.

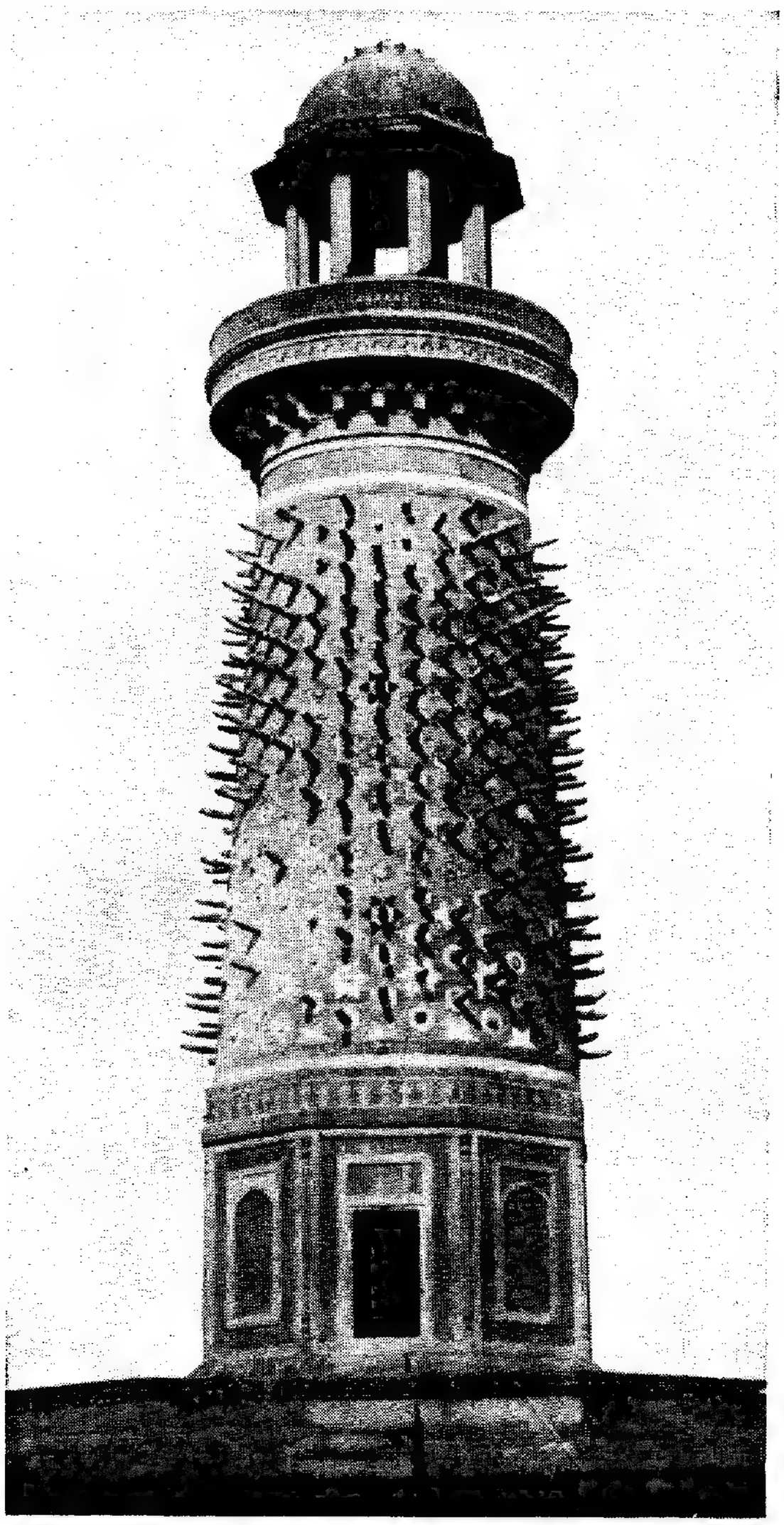
A WONDER BUILDING OF INDIA, THE WORLD-RENOWNED TAJ MAHAL.

This beautiful building, of glistening white marble, is the tomb of the Queen of the Emperor Shah Jehan. It dates from 1640, and tradition declares that the gifted architect was cast from the top to ensure that he should never design another building to rival it.

as to resemble the lace veil of a bride.

The Taj is fronted by cypress trees, and it may be noted that in different pictures these are differently represented. Our coloured plate shows the new trees which were planted in 1898 by the Marquess Curzon, when he was Viceroy, to replace the old ones which were hiding the building. To the Marquess Curzon also is due the restoration of the fabric of this beautiful relic which, at the time he took it in hand, was being sadly neglected.

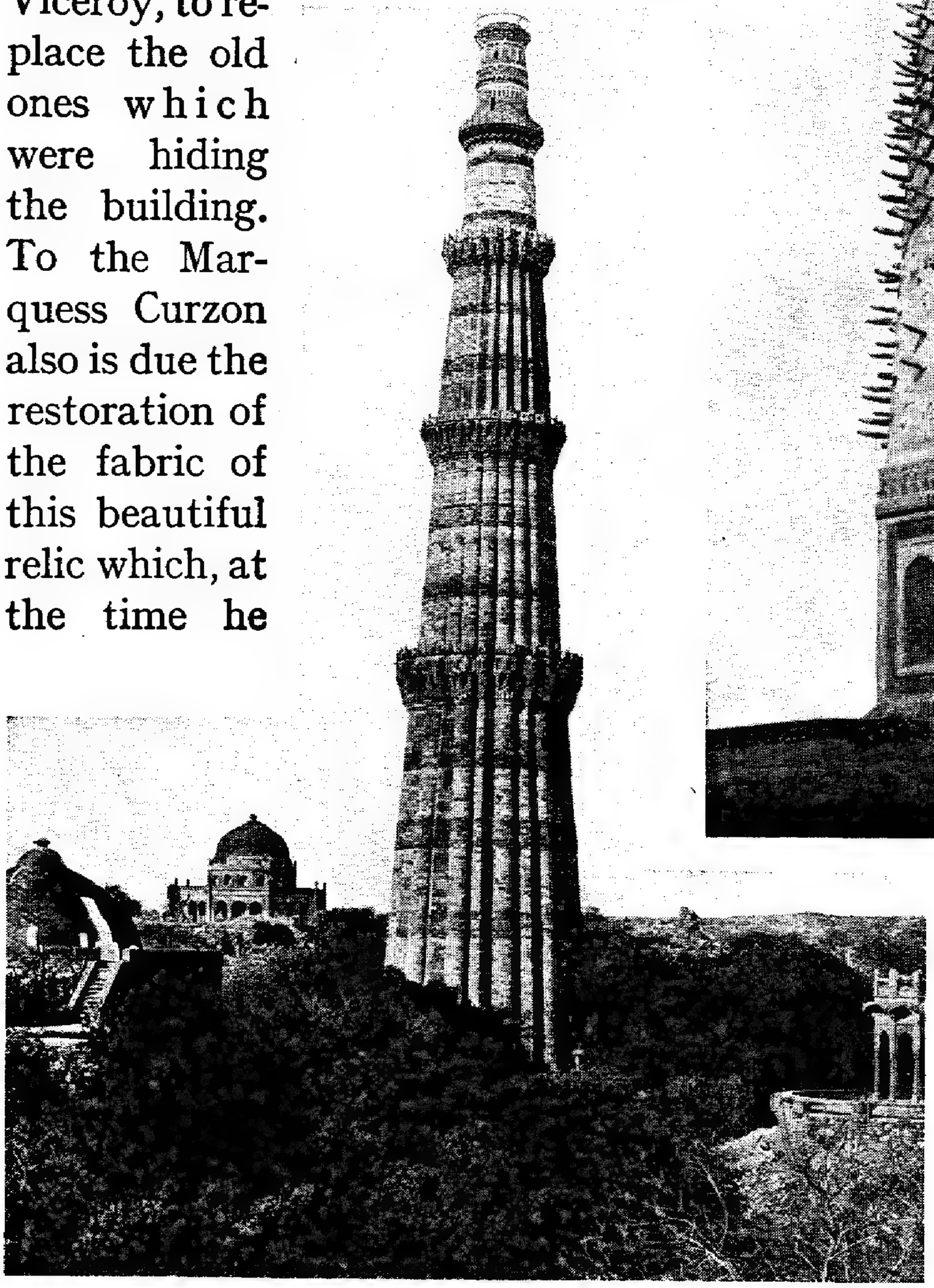
Another splendid building which posterity owes to Shah Jehan is the great Jama Musjid,



[*Press Exclusives.*

AN ELEPHANT'S TOMB, INDIA.

This strange tower, studded with elephant tusks, was erected by Akbar the Great over the grave of a favourite elephant.



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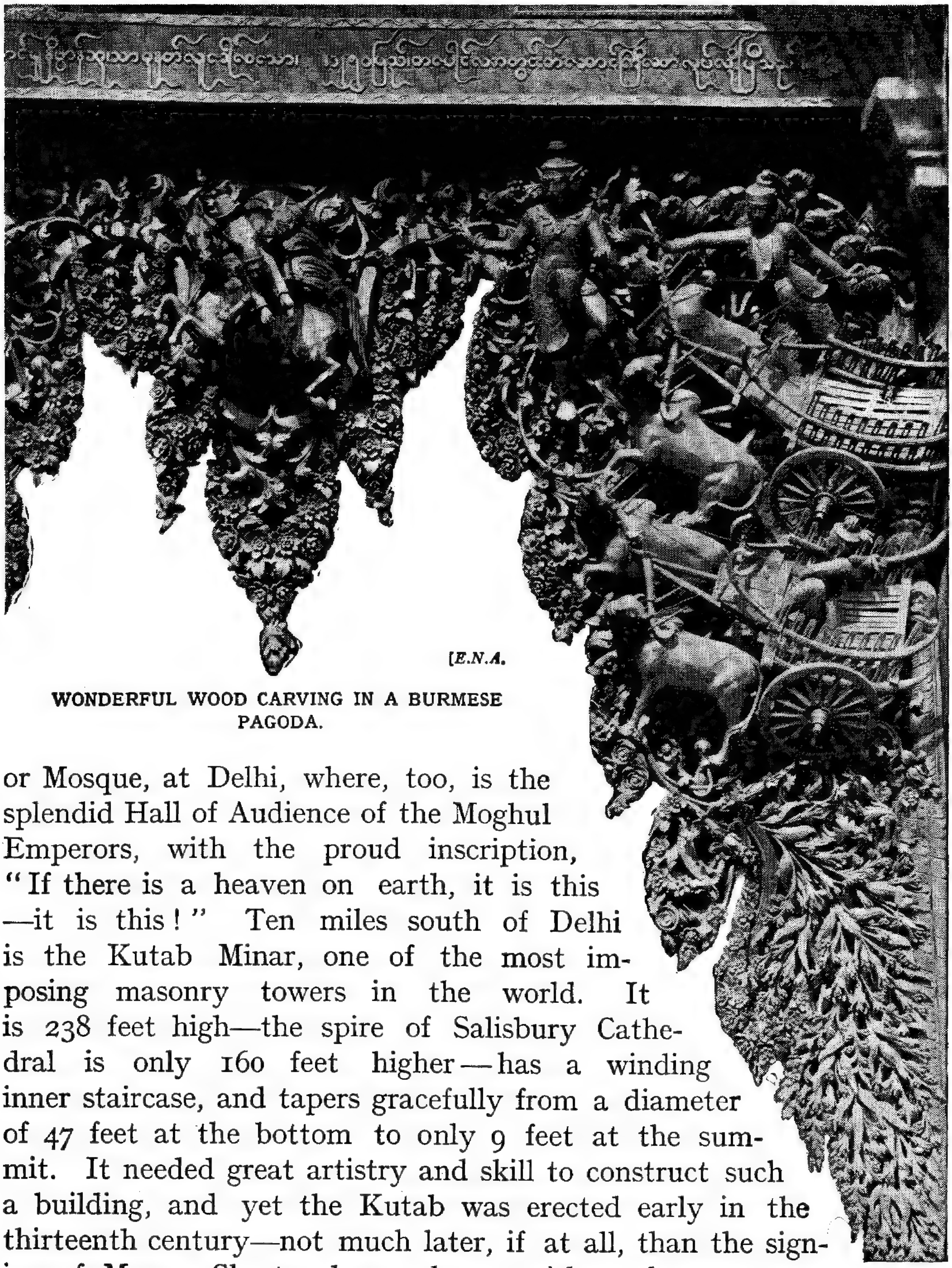
THE KUTAB MINAR, DELHI, BELIEVED TO BE THE HIGHEST PILLAR IN THE WORLD.

"Beyond comparison the loftiest and noblest from which the Mussulman call to prayer has gone forth." It was erected early in the thirteenth century, and is 238 feet high. The diameter at the base is 47 feet, tapering at the top to 9 feet. The tower is decorated by bands of lettering from the Koran.



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WONDERFUL WOOD CARVING IN A BURMESE PAGODA.

or Mosque, at Delhi, where, too, is the splendid Hall of Audience of the Moghul Emperors, with the proud inscription, "If there is a heaven on earth, it is this —it is this!" Ten miles south of Delhi is the Kutab Minar, one of the most imposing masonry towers in the world. It is 238 feet high—the spire of Salisbury Cathedral is only 160 feet higher—has a winding inner staircase, and tapers gracefully from a diameter of 47 feet at the bottom to only 9 feet at the summit. It needed great artistry and skill to construct such a building, and yet the Kutab was erected early in the thirteenth century—not much later, if at all, than the signing of Magna Charta—by workmen with tools even more primitive than those which our English ancestors were using at that period.

Races must be judged to some extent by the buildings they leave

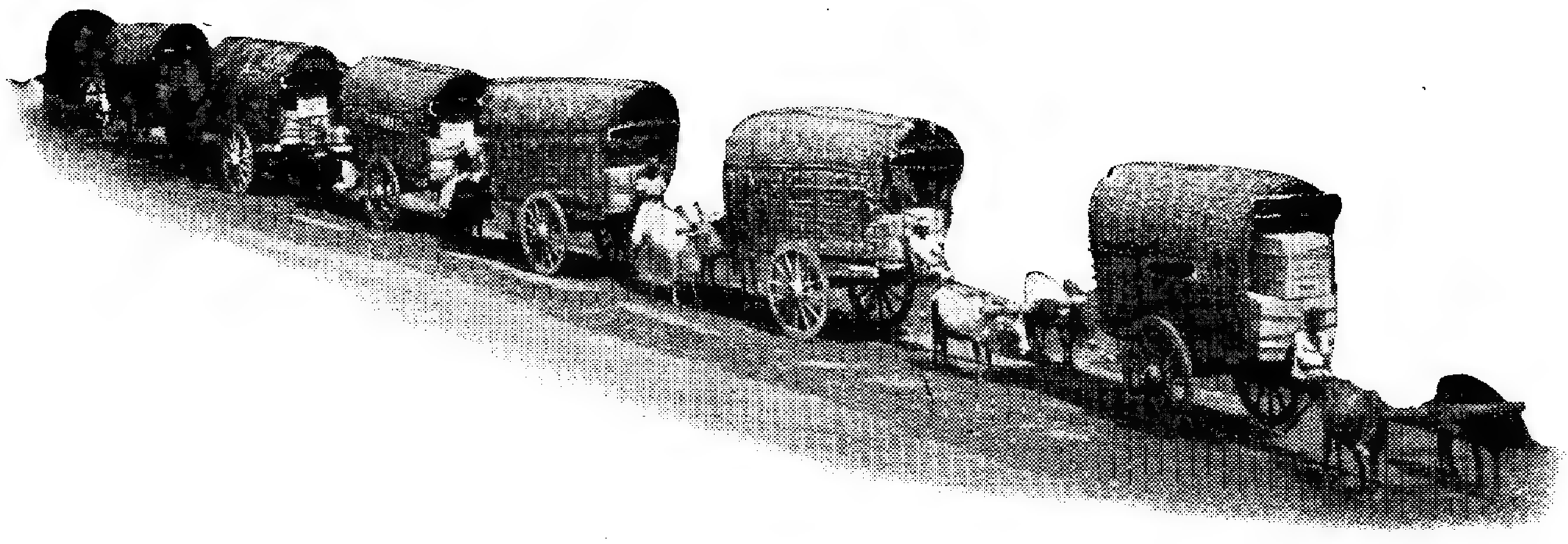
behind them, and rated according to this standard the former inhabitants of India have at least something to be proud of. Their labours may not have been to the actual builders labours of love—in fact, they were probably quite the reverse—but at least they built monuments to their religion and rulers, some of which for grandeur and beauty are not to be surpassed by similar memorials in any other country. Our own modern structures may be more massive, more perfectly finished, and better designed for the purposes they have to fulfil. But a thousand or even five hundred years hence will they strike those who see them with the same sense of wonderment, the same admiration of the artistic feeling and laborious patience involved in their construction, as are inspired even by pictures of the Destroyer god's temple at Ellora or the entrancing Taj Mahal?

OWEN WHEELER.

[*Special Press.*

A WONDERFUL BRIDGE OF CANE, TIBET.

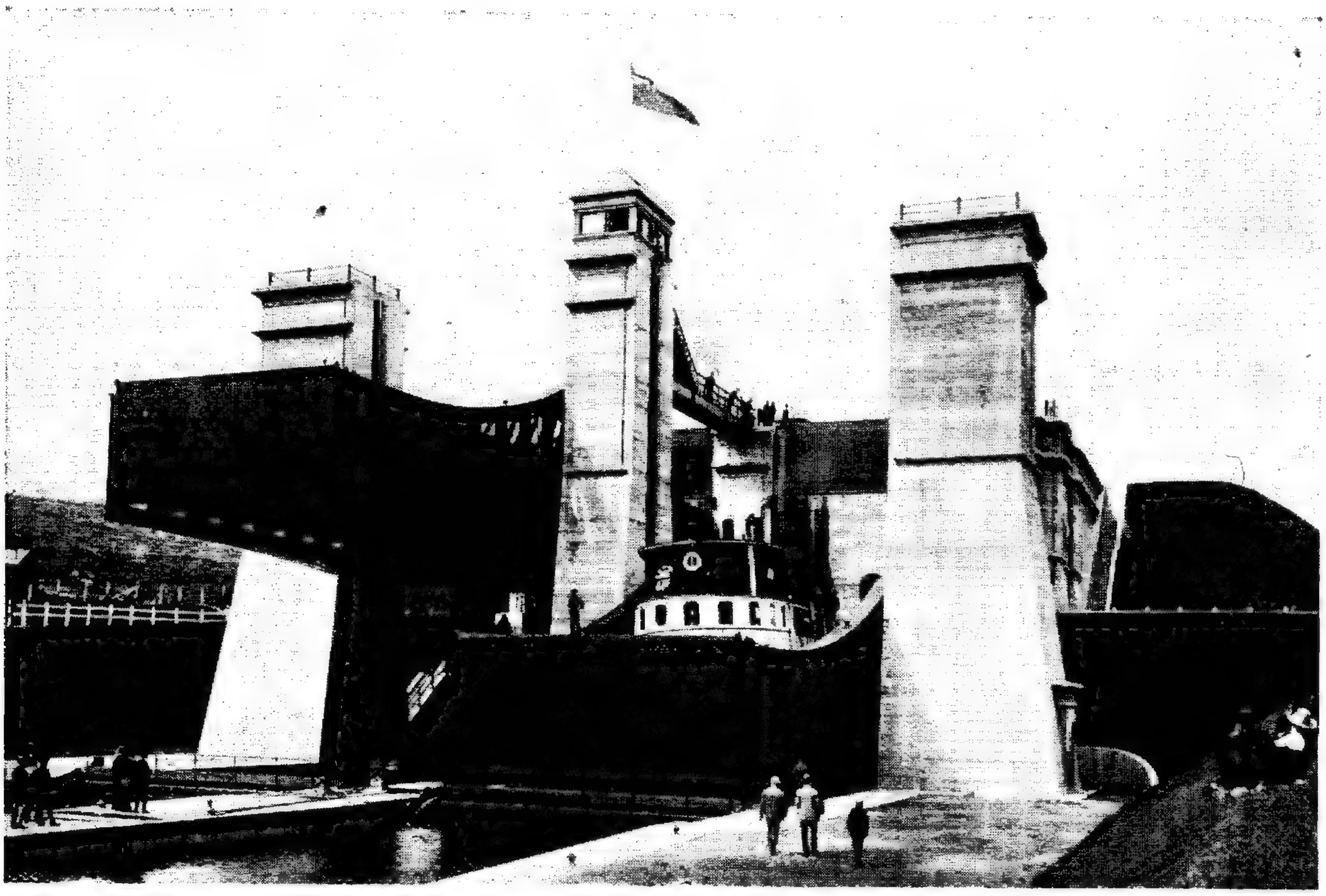
This suspension bridge, entirely of cane, was the work of Abor tribesmen and spans the Dihang River, in Southern Tibet. It is 100 feet high at the ends, but dips to 50 feet above the bed of the river.



OX-DRAWN TEA CARTS, CEYLON.

Wonders of Water Power

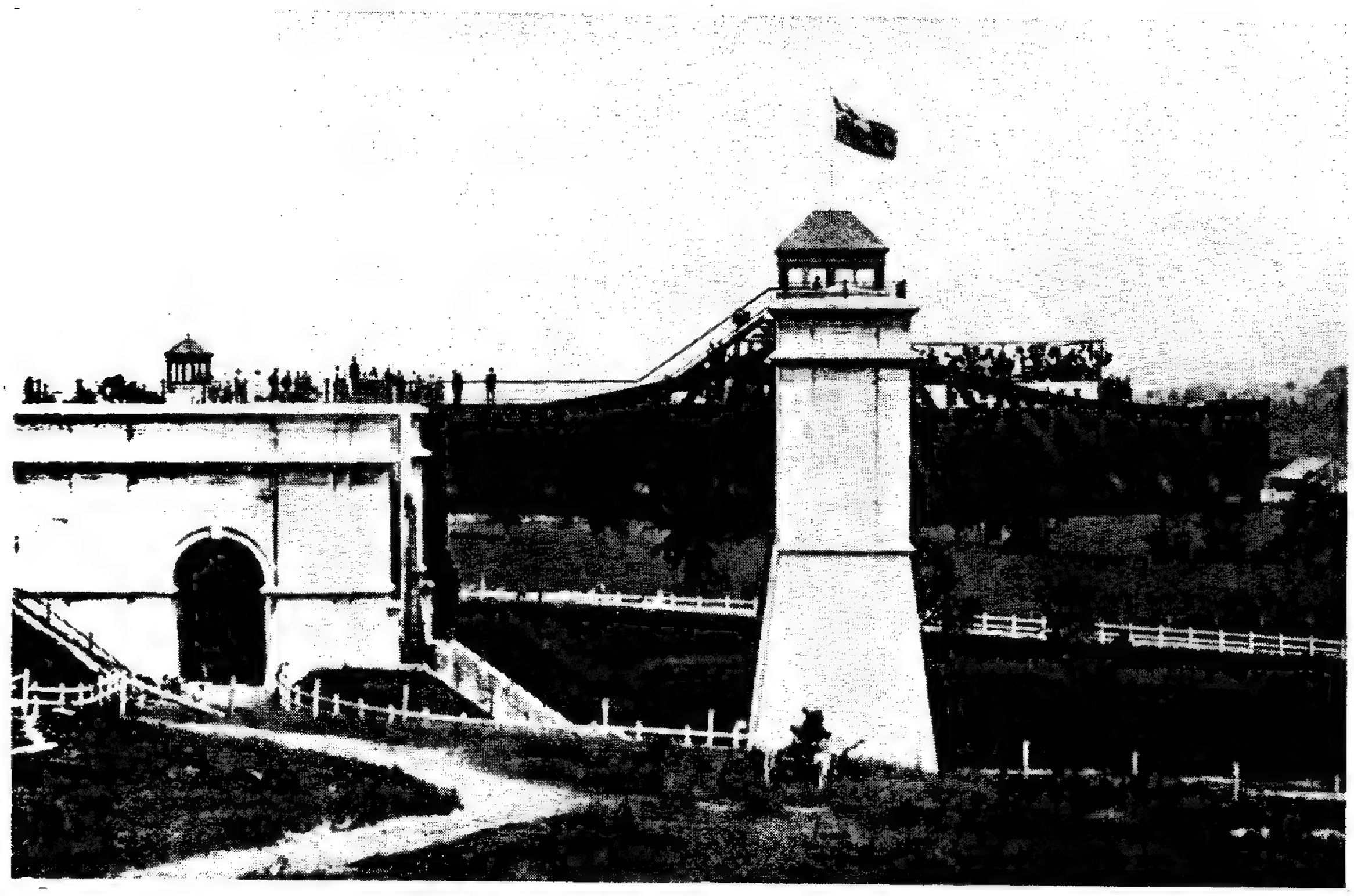
IF water falling from a height is allowed to press against the end of a rod or piston, it exerts power sufficient to push the rod upward, as you can easily test for yourself under any tap. If the water falls from a considerable height the power it will exert is tremendous. On this principle the old-fashioned hydraulic lifts used in buildings were worked; under the lift was a metal shaft, or stem, fitting into a pipe let down into the ground. A water-tank was fixed in a position higher than that to which the lift had to rise, and water was allowed to fall from the tank to the lower end of the pipe holding the lift stem; when the water was admitted to the bottom of the pipe, it forced up the stem, carrying the lift with it. To lower the lift it was only necessary to cut off the flow of water and let the pipe empty, when the lift would sink back as the water flowed out from under the stem.



[*Fleet Agency.*

A HYDRAULIC LIFT LOCK FOR BOATS AND BARGES.

Instead of the ordinary kind of canal lock, which takes some time to fill and empty, this canal, at Peterborough, Canada, is equipped with large tanks which, with vessels in them, are raised or lowered. The work is done by hydraulic power.



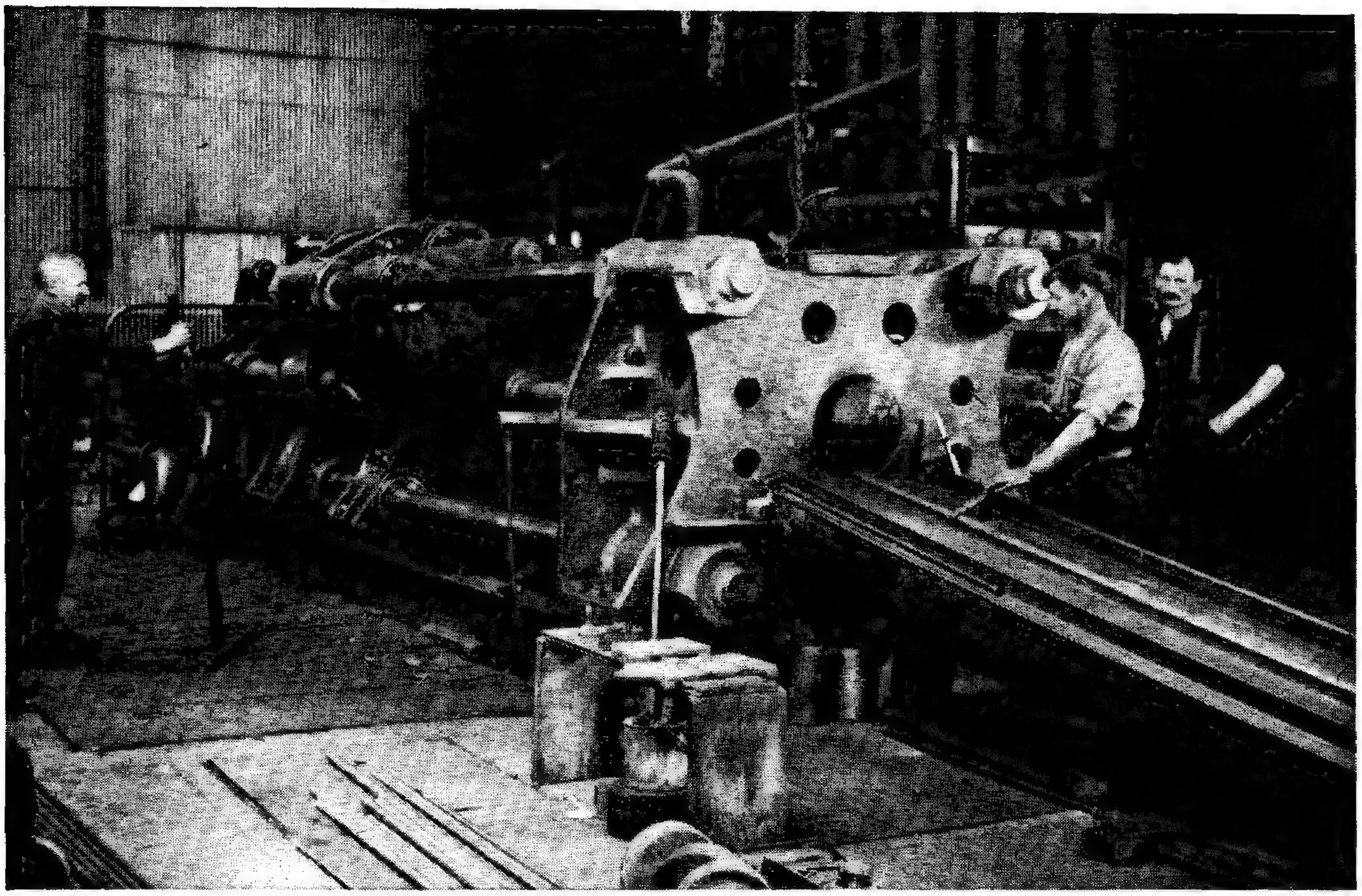
[*Fleet Agency.*

BOAT AT FULL HEIGHT OF LIFT (65 FEET).

The operation takes only a minute and a half. The approximate weight of the water in each chamber of the lock is 1,300 tons.

This water power, or, as it is generally called, hydraulic power, is one of the simplest and cheapest, and at the same time most efficient, forms of power; without heating, and without any pressure but that arising from its own height, the water is used for very many purposes, the old-fashioned lift being only one of them. One ton of water, used in a hydraulic press, will exert a pressure of a hundred tons and more, for it is the height of the water above the press, not its volume, that makes the power.

The hydraulic principle is largely used in connection with canal-locking apparatus, for at canals water is plentiful, and it is easy to get it at the right level to operate machinery below. Especially is this the case with the great canals which connect the American lakes with the Atlantic Ocean. There is a drop of several hundreds of feet in the water-level between Lake Superior and the sea, and vessels from the great lakes are lowered to sea levels by way of the canals connecting the lakes. The canals are controlled by locks which drop a ship as much as 60 feet at one stage. The great lock of the Sault Ste. Marie



[By courtesy of Sir W. G. Armstrong, Whitworth & Co., Ltd.

A FIVE-HUNDRED-TON HYDRAULIC PRESS.

Within the press is a solid brass ingot, which is being squeezed out in thin rods.

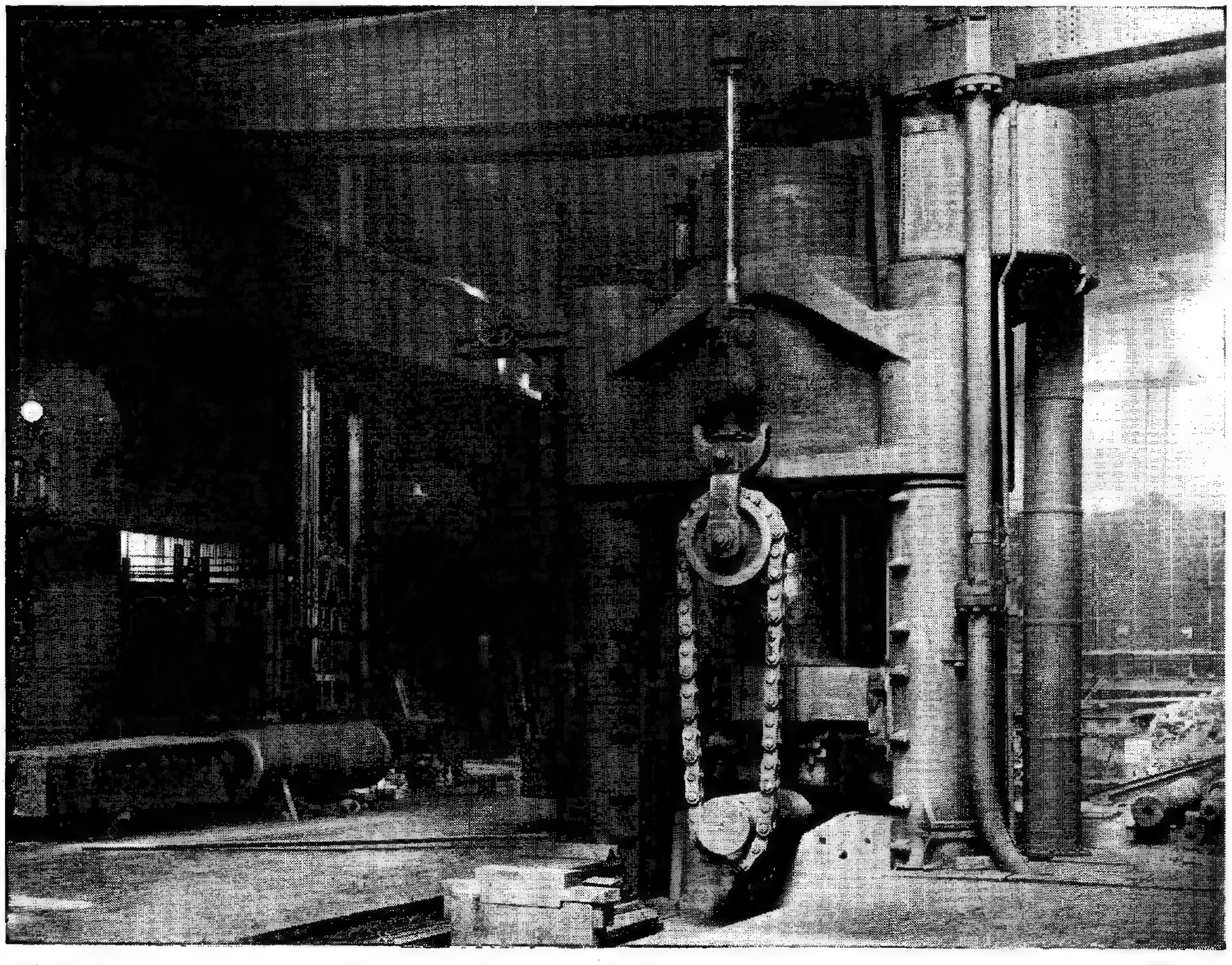
Canal, between Lakes Superior and Huron, the longest lock in the world, has its mighty gates operated by electric power, but it is commoner for this type of gate to be opened and closed by hydraulic power.

At Peterborough, in Canada, is a hydraulic lift lock, which, instead of keeping ships in a lock basin while the water flows in and lifts them to a higher level, picks the ships up bodily and raises them, cargo, passengers and all, some 65 feet, placing them in the water of the higher canal as gently as a child might lift a kitten. And the whole operation takes only a minute and a half. The ram, or stem, which pushes up the lock lift, is $7\frac{1}{2}$ feet thick, and the water pressure under it while the lift lock is being pushed up is 600 pounds to the square inch. This gives a good idea of the enormous pressure exerted by water from a height.

Then there are hydraulic lift bridges, an adaptation of the older type of bridge which broke itself in the middle and canted up to let ships go under, like the central span of the Tower Bridge, on the Thames. In place of opening and canting up endways, the hydraulic

lift bridge raises itself bodily between two great towers to a height that will let ships under; this is much quicker than the old way, and it allows a clearer passage-way under the bridge, while the roadway over it can be built more solidly than if it had to be canted up every time the bridge is opened.

On the gigantic coal piers of Newport News, one of the big coaling centres of the United States, hydraulic and electric power are used in conjunction to run trucks of coal about, to carry them up to higher levels, or to lower them, tipping their contents into the holds of vessels as easily as emptying a matchbox. The loads in the trucks are twenty to fifty tons each, and in addition there is the weight of the trucks themselves. A truck is run into the cage of a great lift, carried down to the next level of rails, pushed off and stopped opposite a ship loading with coal, and there the truck is lifted over the hold of the vessel, tipped till its contents fall out, and then lowered back, empty, to the rails. No gangs of men with shovels are necessary for the loading;

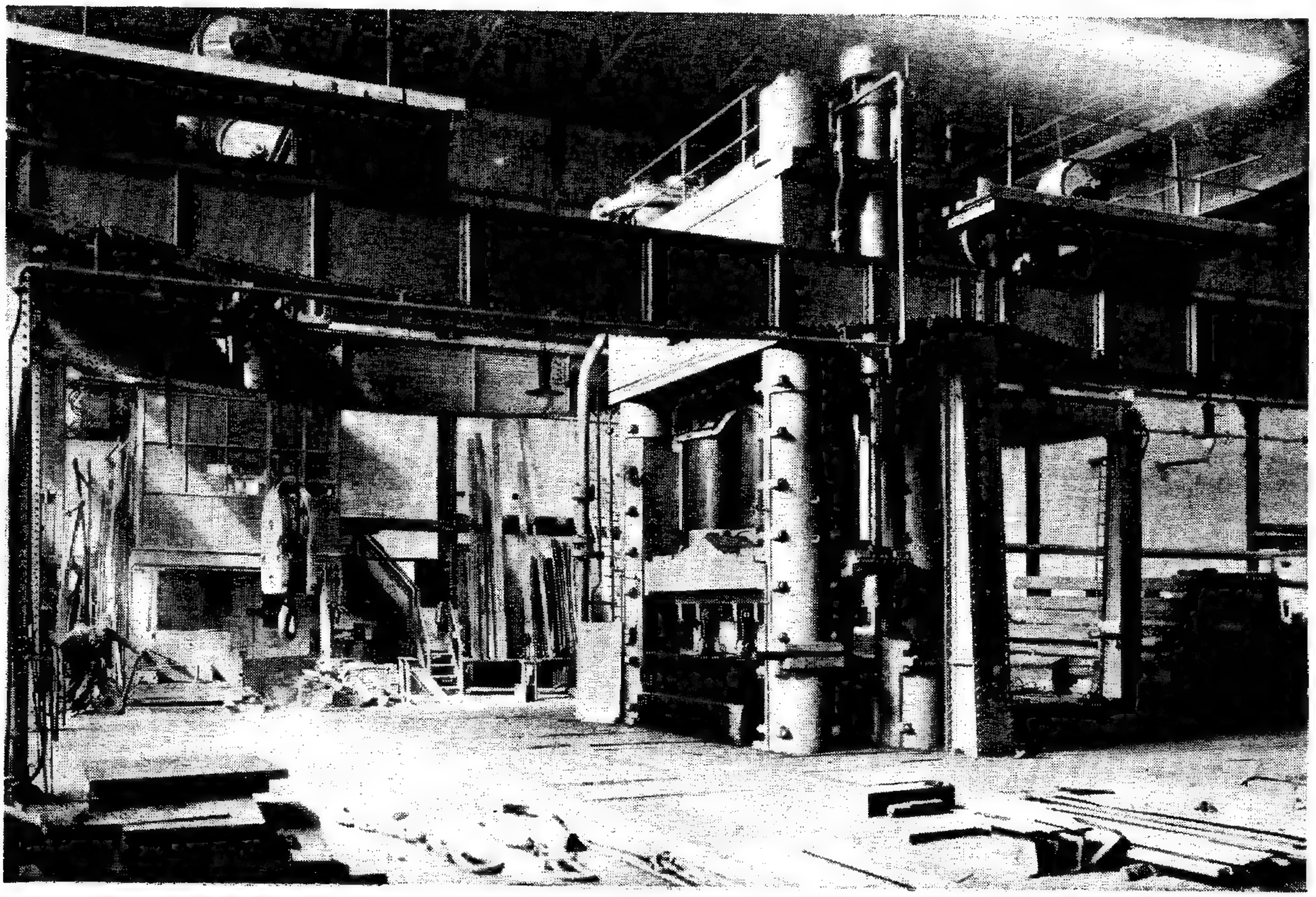


(By courtesy of Sir W. G. Armstrong, Whitworth & Co., Ltd.

A 3,000-TON HYDRAULIC FORGING PRESS, SHAPING A HEAVY STEEL SHAFT.

only separate men in little cabins controlling the movements of the great lifts and cranes.

Probably, however, the greatest hydraulic force is used in the wonderful presses which take steel plates, many inches thick, and shape them as parts of machinery. The framework of the modern motor-car is moulded in hydraulic presses from flat steel bars; a bar is put in the press, and the hydraulic power is applied; the vast pressure exerted bends the steel as if it were paper, and turns it out ready for "machining," or smoothing its surface. The force exerted



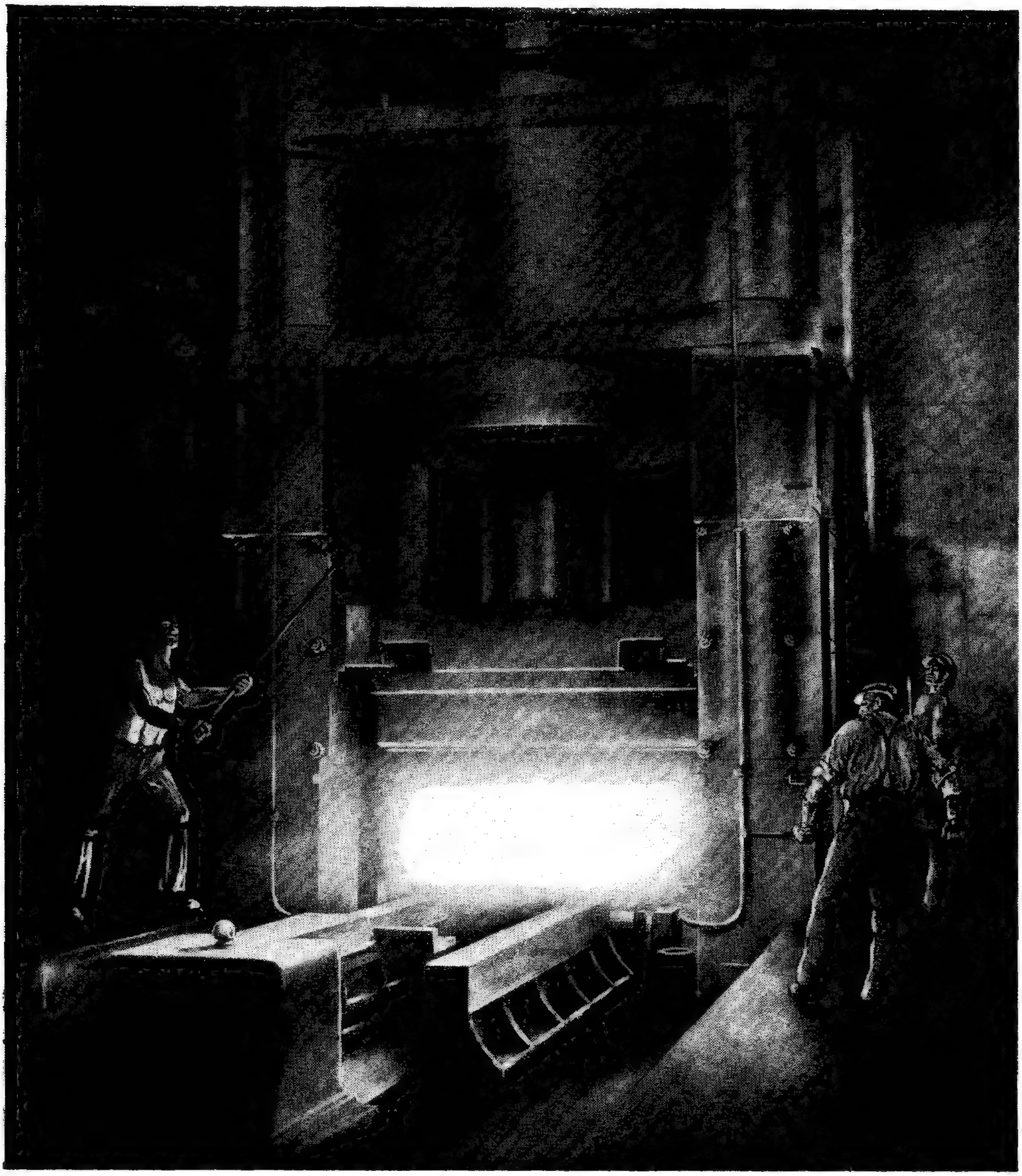
[By courtesy of Sir W. G. Armstrong, Whitworth & Co., Ltd.

A 6,000-TON BENDING PRESS, FOR MAKING ARMOUR-PLATE.

by these presses runs up to many tons to the square inch; yet they are so perfectly controlled that they can be used to bend a pin without crushing it.

All this wonderful power arises simply from the pressure of water, standing at a greater height than the machinery it operates, and used without conversion to steam or any other form of energy. It can be adapted to the driving of turbines, which are something like complicated mill wheels, so arranged that a very little volume of water will do far more work than a greater volume which is not under control.

In this form, hydraulic power is largely used to generate electricity, though, where water is plentiful, as in the case of high waterfalls,

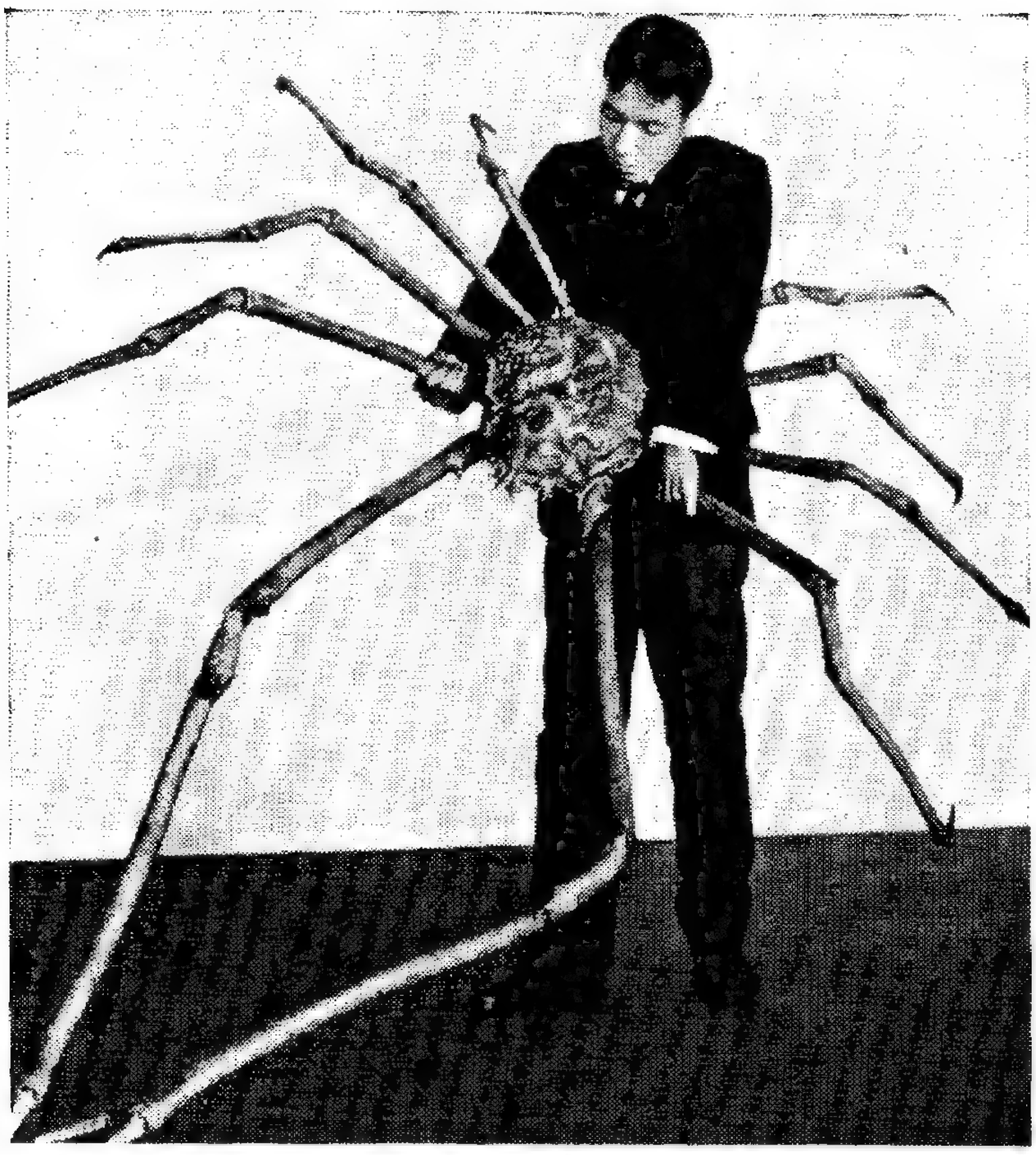


[By courtesy of Sir W. G. Armstrong, Whitworth & Co., Ltd.

A 4,000 TON HYDRAULIC FORGING PRESS AT WORK.

the turbine is dispensed with, and an ordinary water-wheel is used. This, however, is still an adaptation of hydraulic power, one of the greatest driving forces in the world.

E. CHARLES VIVIAN.



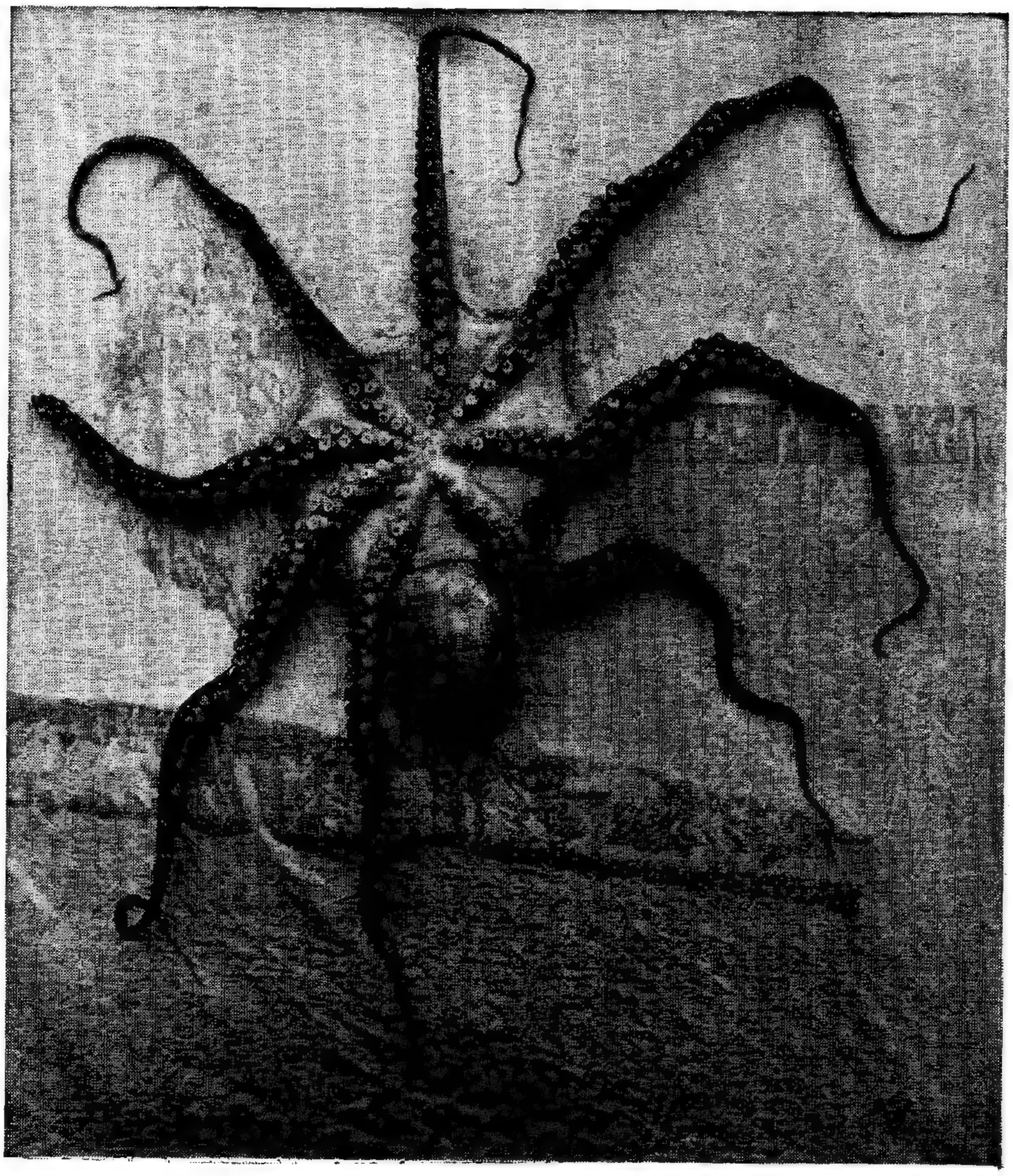
[*Fleet Agency.*

A GIANT SPIDER CRAB.

Legs and Arms

THE body of this unpleasant denizen of the deep seas is only a foot across, but when the first pair of legs are outstretched there is a distance of twelve feet, or twice the height of a tall man, from claw to claw. Specimens have even been known to span eighteen feet. Spider crabs do not haunt the shore, but live on the sea bottom. They have a cunning way of planting on themselves seaweed and anemones as camouflage.

The hated octopus is really a wonderful creature. Its eight whip-like arms, furnished with powerful suckers, have a deadly grip. It has a sharp beak like a parrot's, and its ferocious, protruding eyes, as Frank Bullen wrote, "belong to the Pit." It has the power, when attacked, of ejecting a fluid which darkens all the water round.

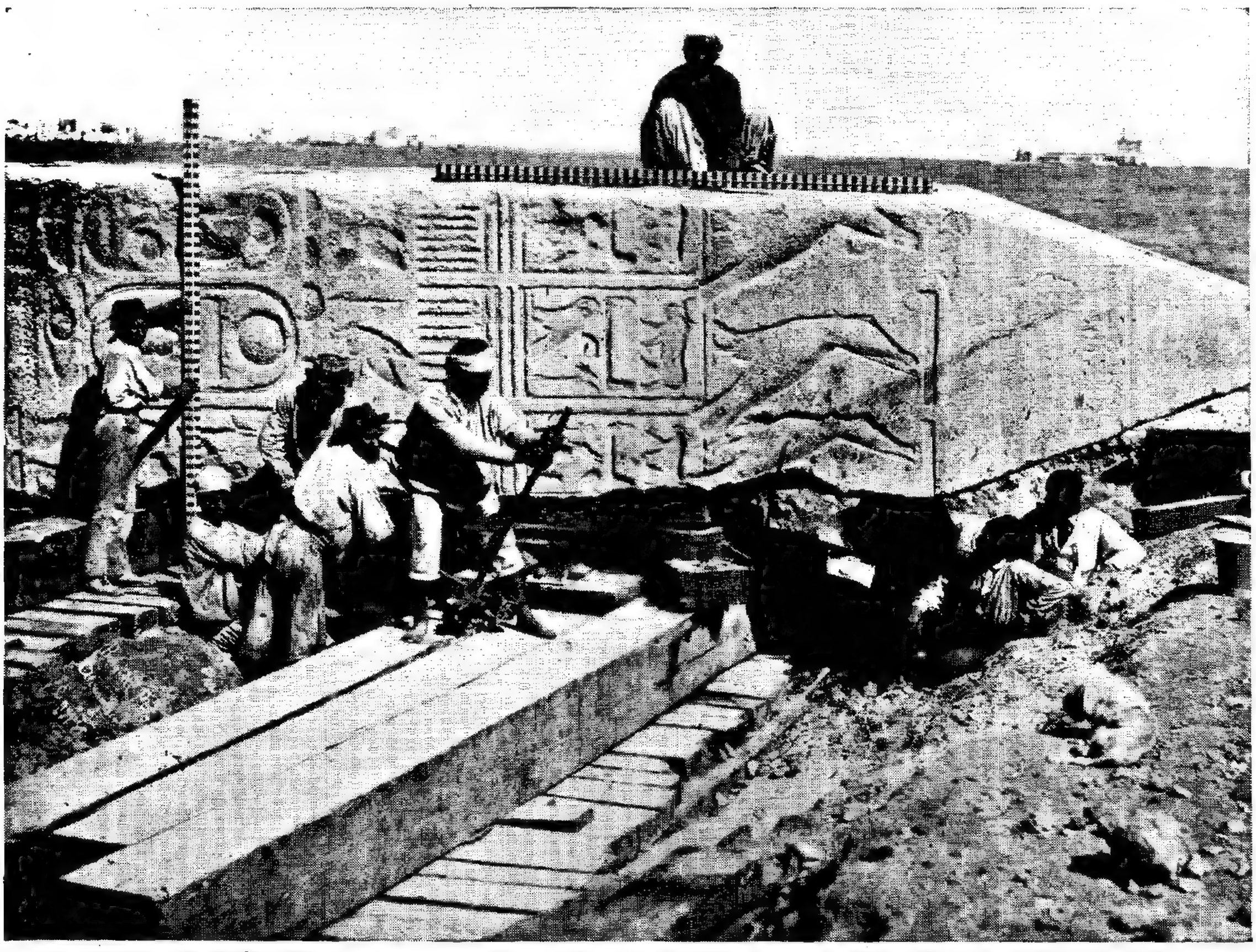


[*Special Press.*

THE UNDER SIDE OF AN OCTOPUS.

London's Most Ancient Monument

NEARLY every child who lives in London, or has visited London, has seen that strange-looking obelisk on the Thames Embankment, near Charing Cross Railway Bridge, which is known as Cleopatra's Needle. It is truly one of the most wonderful objects not only in London but in all the world, and it is wonderful not only for itself but for its history. How many of the thousands who stop to look at it every year could tell you precisely what it is and how it came



PRISING UP THE NEEDLE WITH JACKS IN ORDER TO BUILD THE CASING ROUND IT.

to be in its present position? Yet the story is one of the greatest interest.

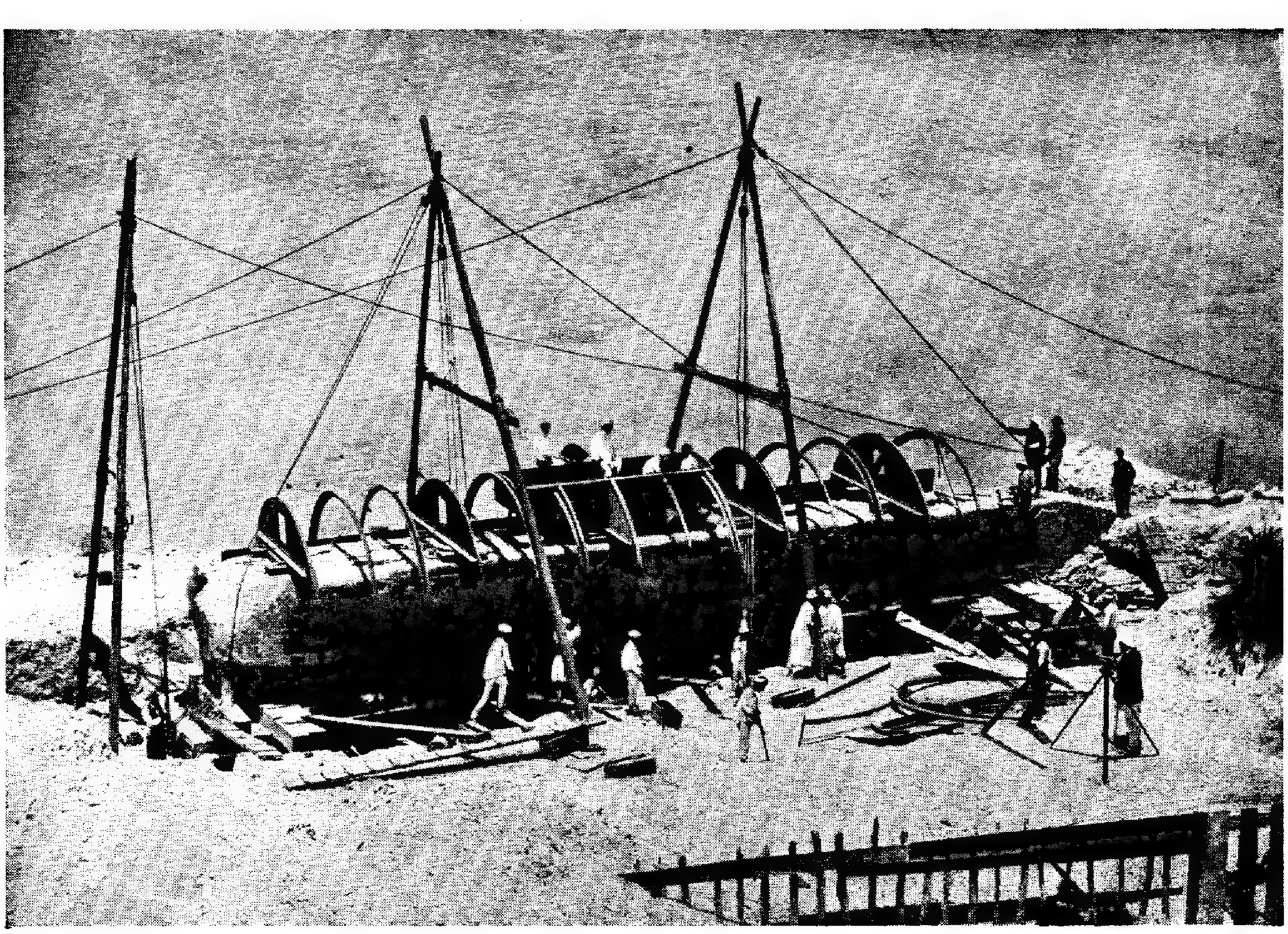
To begin with, Cleopatra's Needle is *nearly 3,500 years old*! Think what that means! Go back all through the long centuries to the birth of Christ, and remember that even then this dingy monument had existed for nearly as long a period. In fact, it is almost safe to say that Cleopatra's Needle was standing in its original position when

Moses led the Israelites across the desert to the Promised Land.

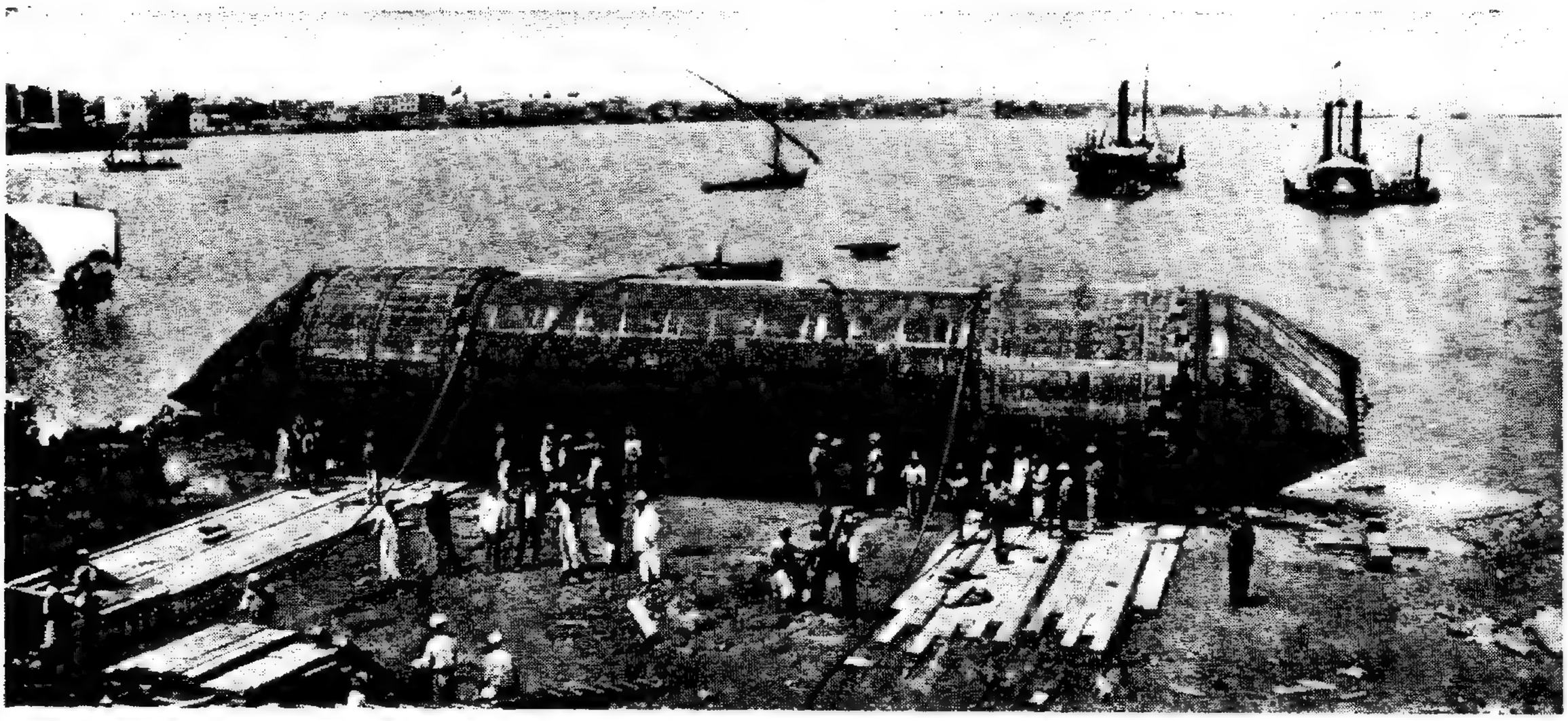
The obelisk is a solid piece of stone, some 70 feet high and weighing 180 tons. It stood in front of the great Egyptian temple at Heliopolis for over 1,500 years. Twenty-three years before the birth of Christ it was removed to Alexandria to adorn the palace of the Cæsars. As Cleopatra had a hand in the planning of this building, the monument and its companion (now in New York) were named "Cleopatra's Needles," which is about as absurd as it would be to call the Tower of London after Queen Victoria.

For fifteen centuries the two needles stood at Alexandria, long after the grand building of the Cæsars had fallen in ruins. Then, some 300 years ago, the monument fell to the ground as a result of the encroaching sea.

After being offered by the Egyptian Government to George IV and to William IV, who both refused, the monument was finally accepted by Great Britain in 1867, Professor Erasmus Wilson some years afterwards generously offering £10,000 to meet the expense of transportation and re-erection. For this sum Mr. John Dixon, a well-known civil engi-



CONSTRUCTING THE CASING ROUND THE NEEDLE.



LAUNCHING THE NEEDLE BY ROLLING IT INTO THE SEA. TWO TUGS ASSISTED IN THE WORK.

neer, undertook to bring the obelisk to London, a distance of 3,000 miles, and put it up. He is said to have lost £5,000 on the transaction.

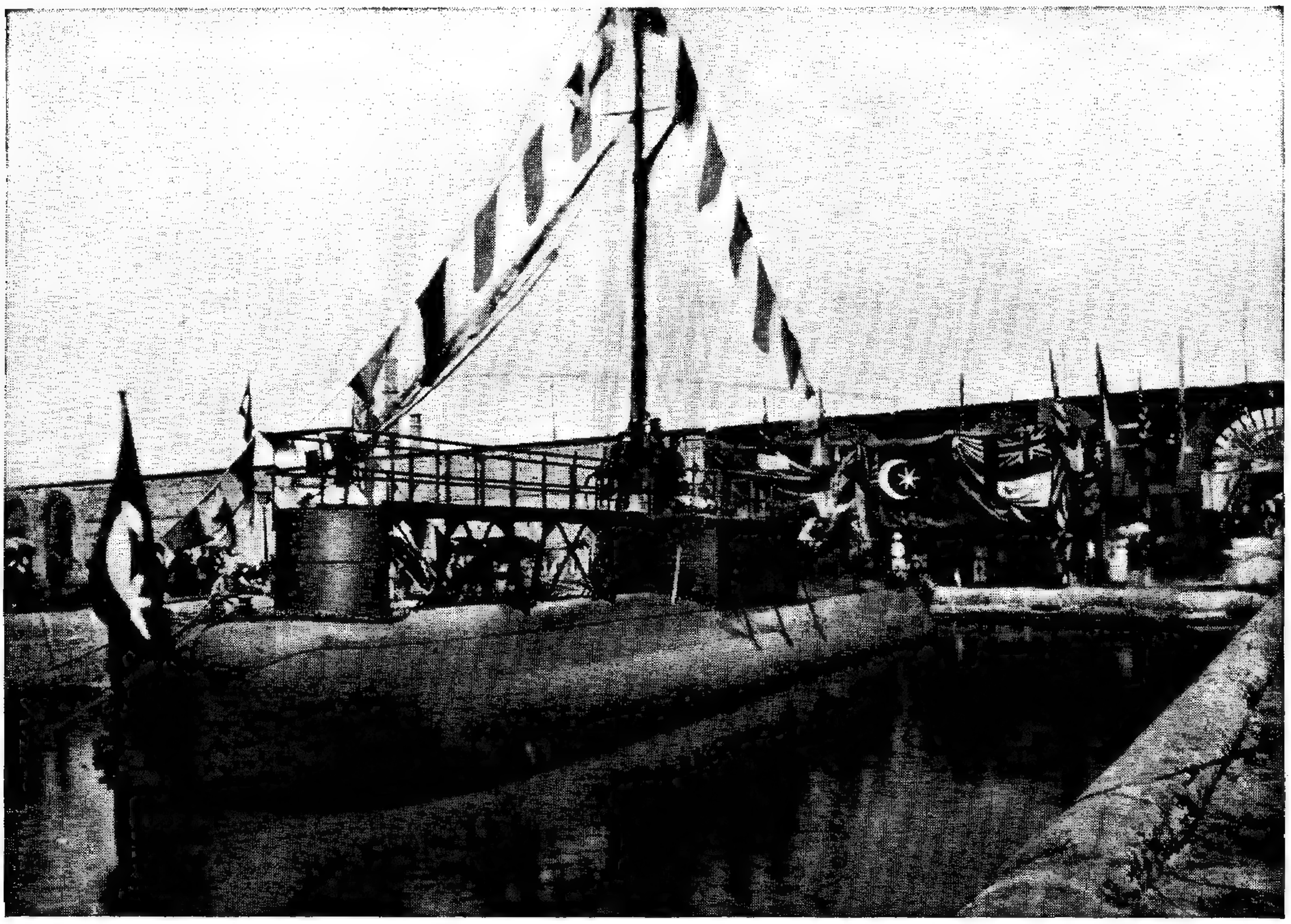
The obelisk was first transformed into a ship, as the photographs show, by being encased in stout timbers covered with strong steel plates. The monument itself lay in the centre of this encasement, which was divided into eight distinct watertight compartments to impart the buoyancy to enable it to float.

When ready, the floating cylinder was rolled into the sea and, towed by two tugs, was taken into dock and fitted out as a sea-going craft, appropriately named the *Cleopatra*. The vessel was 92 feet long and 15 feet in diameter. A cabin and rail were fixed on top; two bilge keels, 40 feet long, were riveted on either side; and a mast and rudder were placed. On September 21, 1877, the *Cleopatra*, with an English captain and a crew of five Maltese, left Alexandria in tow of the *Olga* for London. For the first twenty days all went well, but on Sunday, the 14th October, when in the Bay of Biscay, a great storm arose. A big sea caught the *Cleopatra*, turned her completely on her beam ends, and carried away her mast. A desperate effort was made to right her, but without success. The captain of the *Olga*, seeing the danger all were in, decided to disconnect the two vessels, and the cylinder was cut adrift. A little later, when the wind had fallen, the crew of the *Cleopatra* signalled for assistance.

The second officer of the *Olga* begged that a boat be lowered and asked for volunteers. In a few minutes five able-bodied seamen,

under the brave officer, put off from their vessel, but their little craft was swamped and the men were drowned. Later, a line was thrown from the *Olga* over the *Cleopatra* and by means of it a boat was hauled from one vessel to the other and the sailors on the Needle were saved. Next morning the *Olga* set sail for Falmouth, reporting the loss of the men and the abandonment of the Needle in the Bay.

Sixty days later a telegram arrived saying that the lost monument had been found by the steamer *Fitzmaurice*, and towed into Vigo, in



THE GOOD SHIP "CLEOPATRA" READY FOR THE VOYAGE TO ENGLAND

Spain. The owners of the *Fitzmaurice* were awarded £2,000 salvage. From Vigo the Needle was finally brought to the Thames by the steamer *Anglia*, where she arrived on January 20, 1878.

The column was towed up the river at high tide, and placed on a specially prepared cradle. At three o'clock on September 12, 1878, the final ceremony of lowering the obelisk into position took place.

A remarkable collection of articles was placed in two large hermetically sealed jars underneath the pedestal. These included a standard foot and pound ; a bronze model of the obelisk, on the scale

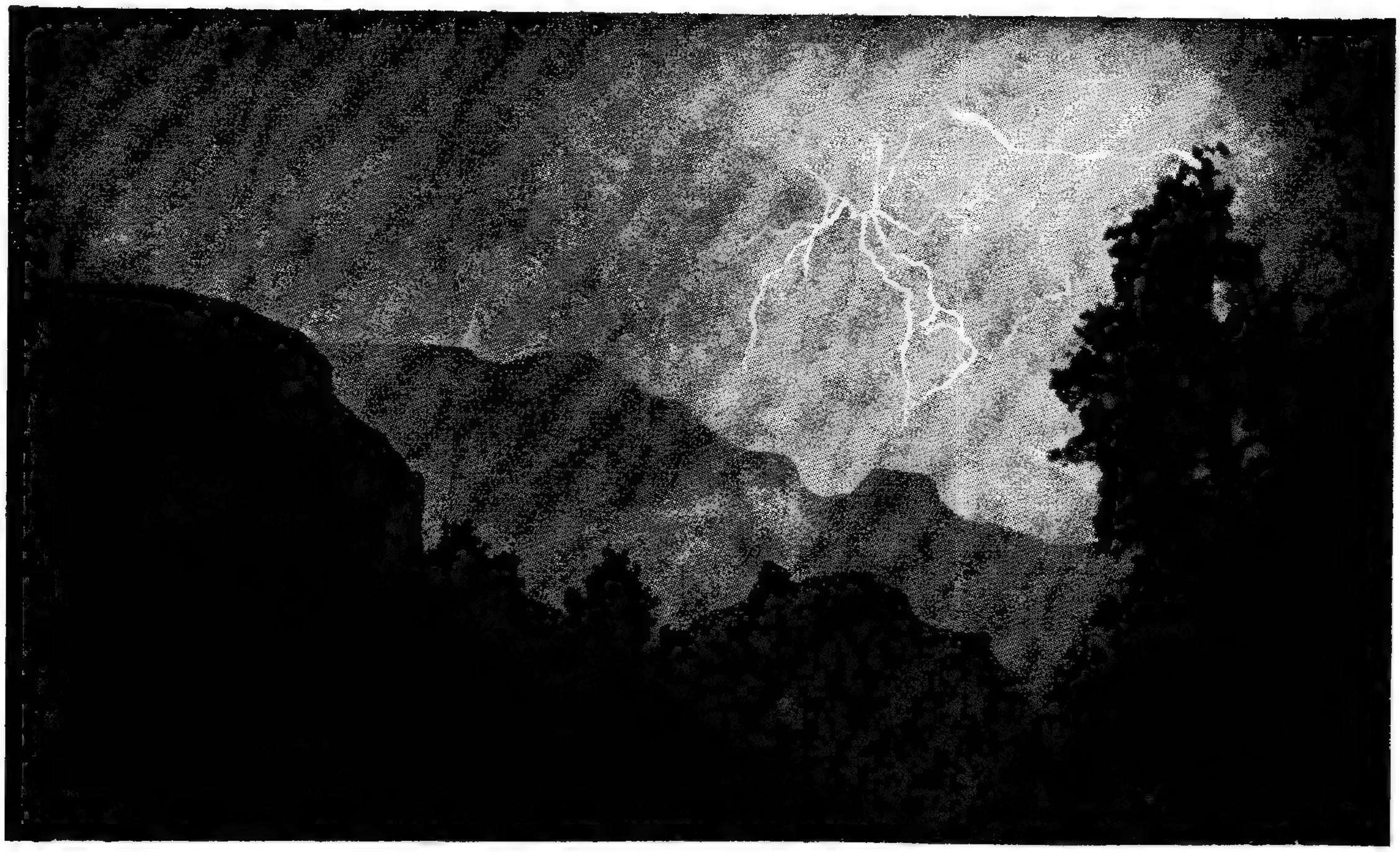
of half an inch to the foot; a memorial printed on vellum, giving a brief account of the removal of the obelisk; jars of Doulton ware; a piece of the obelisk stone, chipped in levelling the base; a complete set of the British coins then current, from a farthing to a £5 piece; a parchment copy of Dr. Birch's translation of the obelisk hieroglyphics, or writing; a standard gauge to one-thousandth part of an inch; a portrait of Queen Victoria; Bibles in several languages; a Hebrew Pentateuch; the Arabic Genesis; a translation into 215 languages of the sixteenth verse of the third chapter of St. John's Gospel; Bradshaw's railway guide; a shilling razor by a famous maker; a case of cigars; a box of assorted pipes; a box of hairpins; sundry articles of feminine adornment; a feeding bottle, and children's toys of the period; a gentleman's walking-out and evening dress suits; a model of the hydraulic jack used in raising the monument; wire ropes and specimens of marine cables; a map of London; current copies of daily and illustrated papers; photographs of a dozen pretty English women; a two-foot rule; a London directory; and a copy of Whitaker's Almanack for that year.

What, one wonders, would Cleopatra have thought of such a strange assortment? And the builders, who lived so many, many centuries before her time?

And do the stalwart policemen who pace the Embankment day and night know what a varied treasure they guard?

HAROLD J. SHEPSTONE, F.R.G.S.

TWO OF NATURE'S WILDEST MOODS



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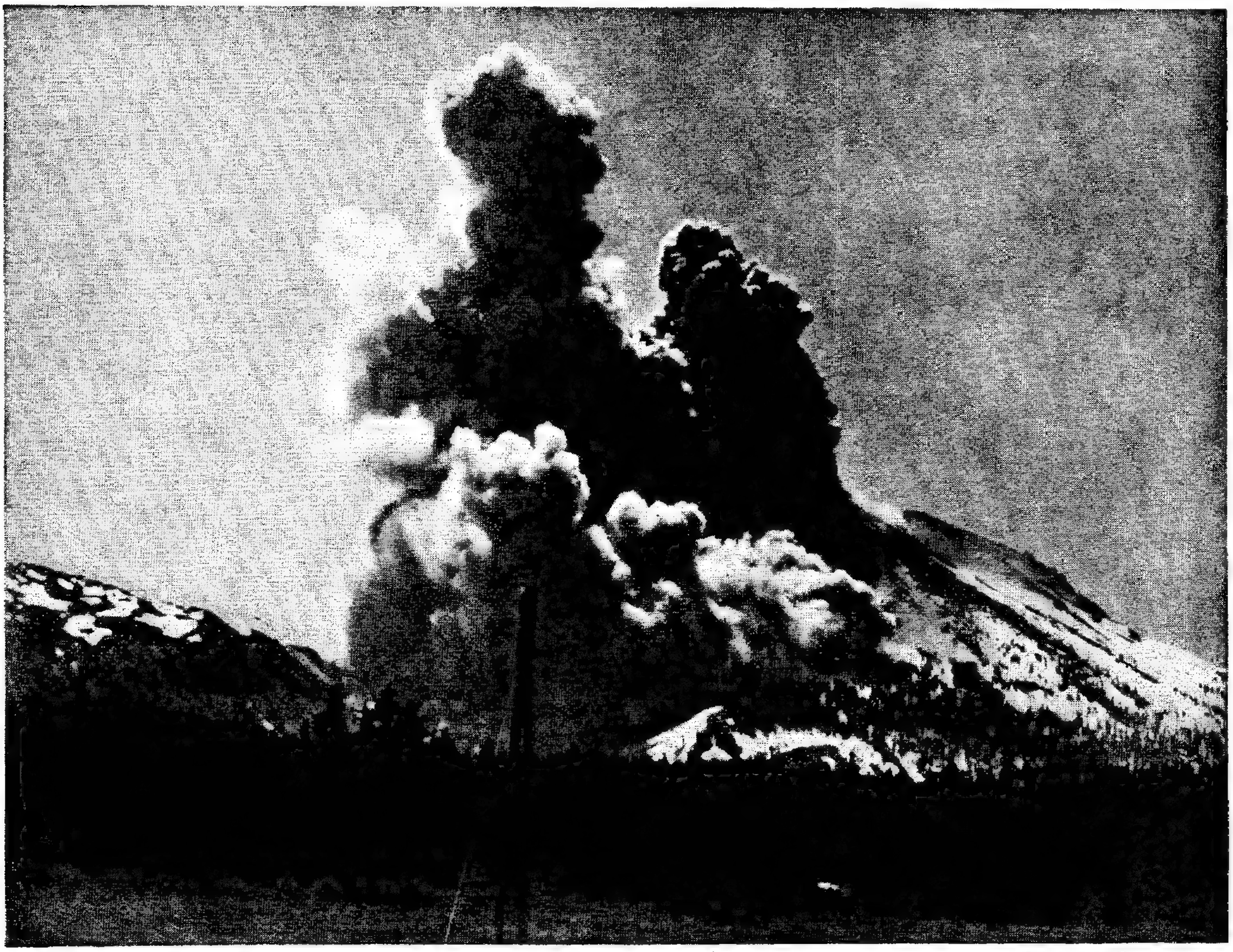
LIGHTNING PLAYING OVER THE GRAND CANYON, ARIZONA.



[*Sport & General.*

MOUNT LASSEN, CALIFORNIA, IN ERUPTION,
after being regarded as extinct for more than 110 years. The smoke and steam rose to a height of 4,000 feet.

A SECTION OF THE GREAT ASSOUAN DAM. [*Topical*

Harnessing the Rivers:

Some Wonderful Feats of Engineering

IN no field of enterprise have engineers earned greater fame than in the erection of dams, those massive concrete structures by which volumes of water are impounded for the water supply of great cities and for irrigation and other purposes. It was in harnessing the river Nile that they first showed what could be done in this branch of engineering science.

Egypt being virtually a rainless country, the farmer there—and the citizen, too, for that matter—has to rely upon the Nile for his water supply. When the river rises, as it does annually, it inundates the valley through which it flows, leaving a deposit of "silt" of such fertility that luxuriant crops of cotton, sugar-cane, indigo, tobacco and maize can easily be cultivated. Unfortunately, however, this historic stream is very uncertain, rising higher some years than at others. If the rise was low it meant famine, while unusual height spelt equal disaster, as the crops were ruined.

Engineers have in recent years changed all this by throwing mighty dams across the river at four different points, thus forming huge reservoirs from which the farmer can draw water as required, whatever the season. £25,000,000 have been spent on the work,

but millions of acres of otherwise desert land have been reclaimed and made fertile.

The first of these great dams, or barrages, is at Delta, just below Cairo. It was begun by the French, but when an attempt was made to hold up the stream with it, the structure cracked and began to move bodily towards the Mediterranean. Mehemet Ali, the then Khedive of Egypt, ordered the dam to be taken away, work which would have entailed a cost of £500,000. At this juncture the celebrated irrigation engineer, Sir William Willcocks, came on the scene, and declared that for the sum it would cost to take the barrier down he could make it good, and he was told to go ahead.

When Mehemet Ali heard that a supply of large stones would be needed for the work he sent for the engineer and told him to use the blocks of which the Pyramids were built. The engineer knew what infamy would attach to his name if he demolished such ancient monuments, so, taking out his notebook, he pretended to make calculations; then, turning to the tyrant, he declared that the cost of transporting the stones from the Pyramids would be greater than that of quarrying them in the mountains, and so the monuments were saved.

The Delta barrage was successfully repaired, bringing 1,700,000 acres of land under cultivation. A second dam was erected at Assiout, some 250 miles above Cairo, a third at Esneh, 240 miles farther up the river again, the fourth and last being the great Assouan dam at the First Cataract, one of the most famous structures of its kind. It possesses 180 sluice gates, and holds up 2,500 million tons of water, a sufficient quantity to form a lake that would stretch from London to Nottingham, and to supply the domestic needs of every city, town and village in the United Kingdom.

This great dam was built across the First Cataract, where the river flowed through five channels at a speed of 16 miles an hour, with a turbulence almost, if not quite, equal to that of the Niagara rapids. Here, amid the deserts and mountains of Upper Egypt, vast workshops were set up, and accommodation provided for 20,000 natives, with their European overseers. For years this great army toiled under the blazing tropical sun, quarrying the stone, conveying it to the site, excavating the channels one at a time, and gradually building up the great wall. In order to avoid the ever-present danger of sunstroke, tents were set up at many points, each containing a bath,

an ice-box, and a telephone. If a man succumbed to the heat, he was hastily placed in the nearest iced-water bath to await the doctor, who had already been summoned by telephone. Consequently, hardly a life was lost by sunstroke.

Only one channel, of course, was tackled at a time. Stones weighing from one to twelve tons each were flung into the opening above and below the site of the dam. So violent was the current that the engineers had sometimes to fasten several of the largest

[General Photographic Agency.

AN OVERFLOW OF THE CORNELL DAM OF THE GREAT CROTON LAKE RESERVOIR, SUPPLYING NEW YORK WITH WATER.

stones together with steel wire, rope them to a truck, and send truck and all flying into the gap. As soon as a channel had been closed, the water was pumped out, the foundations secured, and the wall built, when the water was permitted to flow in again and to pass downstream by means of the sluice gates. Channel number two was then mastered in the same way, until all the five openings were spanned by a continuous solid concrete structure, 130 feet high, 100 feet wide at the base and tapering to 24 feet at the top, and $1\frac{1}{4}$ miles in total length.

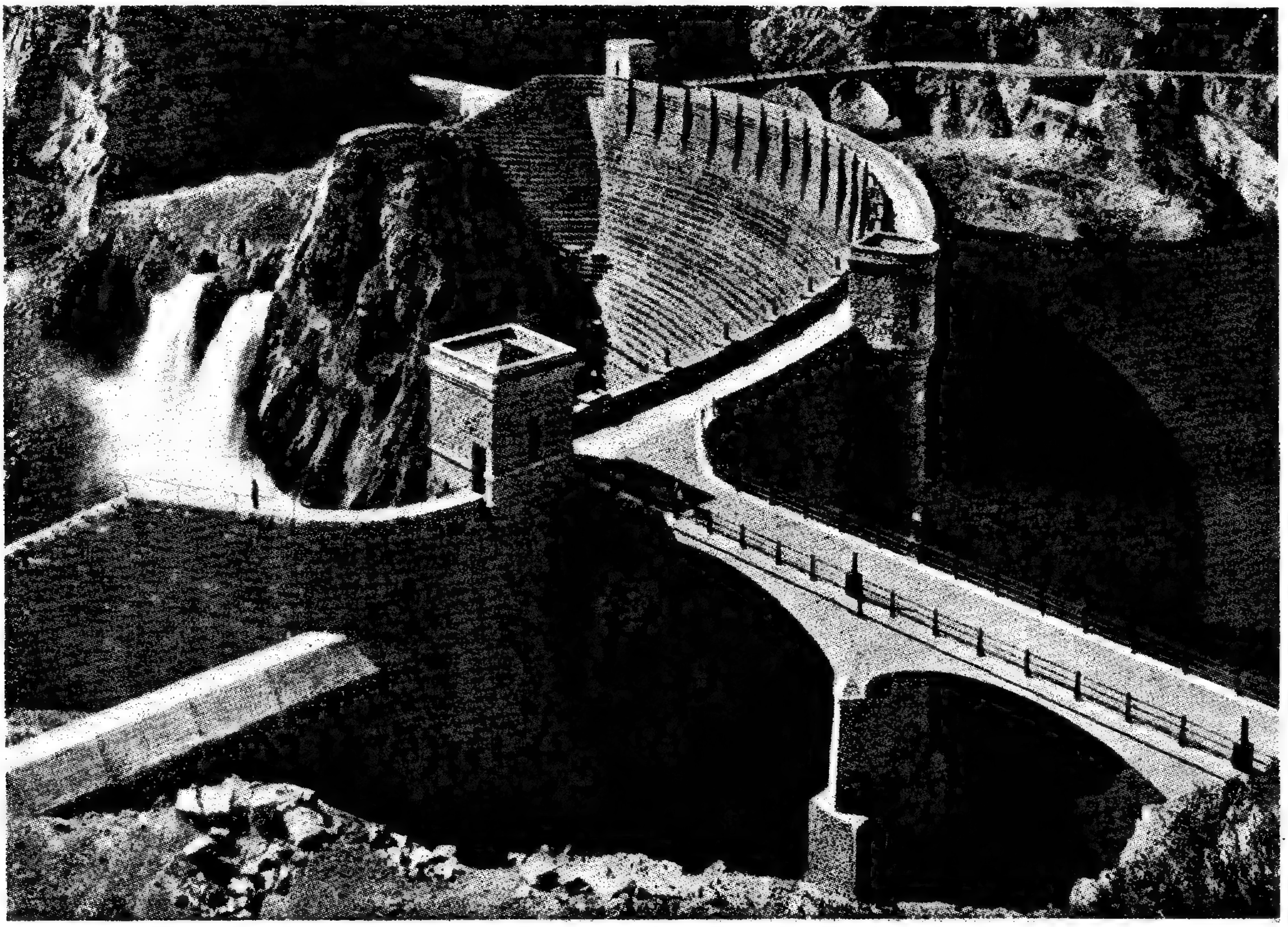
Five years later the great structure was raised another 23 feet, and strengthened by increasing the thickness of the wall. All told, a sum of £4,000,000 was spent upon it, but it has brought over a million acres of hitherto desert land under cultivation. At the present time yet another great work of the kind, the Sennar Dam, is being constructed, as funds permit, on the Blue Nile, about 150 miles south of Khartoum. It will be one of the largest in the world, and is expected eventually to bring over 3,000,000 miles of now useless land under cotton cultivation.

In the Blue Mountains of New South Wales is the great Burrinjuck Dam, the highest in the Empire. Its erection meant the building of a massive wall in a deep gorge and across the bed of a river subject to floods, the sides of the gorge being so steep that it was impossible to establish workshops upon them. Furthermore, the water stored here had to be carried a distance of 266 miles, equal to a journey from London to Newcastle, and there distributed by miles of canals over a million acres of parched land. It was a project that called for all the resource, pluck, and determination of the engineers. It entailed an expenditure of £3,000,000, and demanded five years of constant toil on the part of an army of men, during which stern battles had to be waged with raging floods which frequently swamped the works. Such was the strength of the current that on several occasions cranes, heavy pieces of machinery and valuable tools were carried 50 miles and more downstream, whence they were only salved with great difficulty.

The dam is 236 feet high, or 34 feet higher than the Monument commemorating the Fire of London. It is 186 feet thick at the base, tapering to 18 feet at the top. By holding up the waters of the Murrumbidgee River, it has created an artificial lake among the mountains, having a surface area of 12,740 acres, with a depth of 220 feet.

By means of similar wonderful structures the engineer has accomplished wonders in fighting the famine scourge which has so often menaced the peoples of India. All over that great country there are what are termed " tanks," reservoirs as large in area as a good-sized English county, created by the erection of dams. From these artificially formed lakes water is carried over the thirsty land by means of canals, the main channels of which are as wide and as deep as the Thames at London Bridge. The great Ganges Canal, with its distributing channels, is 9,900 miles long !

Some of these Indian structures are of immense size, a mile and more in width, and 200 feet and more in height. Their erection demanded both skill and daring on the part of the engineers. In building a dam across the Periyar River, watchmen, with drums and blazing fires, had to guard camp at night against the curiosity of wild elephants, who constantly visited the works, uprooting milestones, dismembering new masonry, tramping down embankments, playing with cement barrels, chewing bags of cement and blacksmiths' bellows,



[*E.N.A.*

THE ROOSEVELT DAM, ARIZONA.

This semi-circular structure is 280 feet high, and impounds sufficient water to cover, to the depth of a foot, 1,284,000 acres, an area equal to the county of Lancashire. By its means extensive tracts of what was thorny desert have been turned into fertile land.

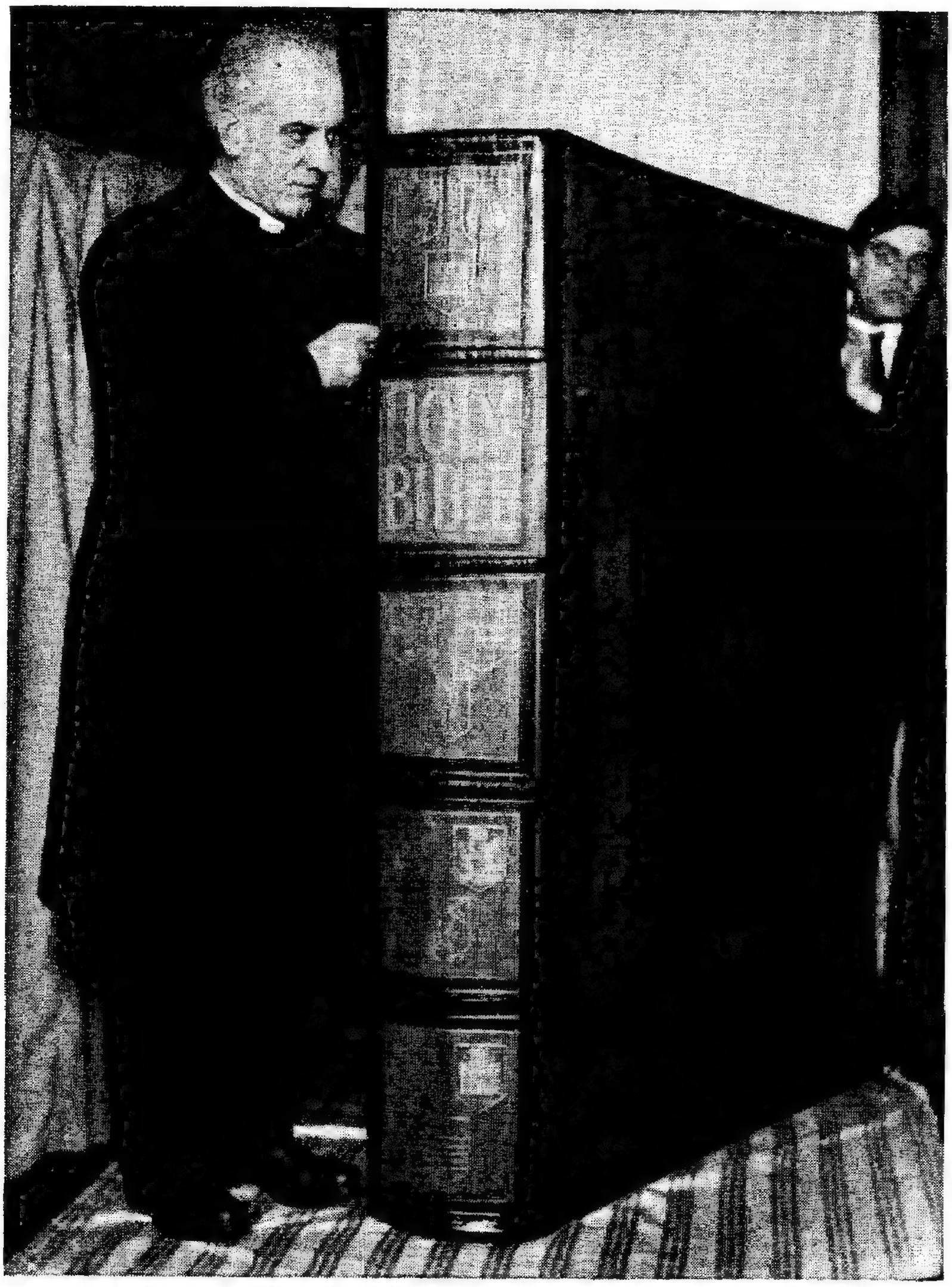
crumpling up zinc sheets, kneeling on buckets, and doing everything that mischief could suggest and power perform.

The longest of all dams is that of Bassano, built to hold up the waters of the Bow River, in Alberta, Canada, in order to increase the dairying and livestock output of that province. It is 7,280 feet long, but it is only part masonry and part rubble and earth.

In the United States also we find many daring examples of what engineers can accomplish in harnessing rivers. The most conspicuous

of these feats, perhaps, is the great Croton Dam, erected to hold up the waters of the river of that name for supplying New York. It is about 1,200 feet long, and has a maximum height of 300 feet from rock to crest. This makes it the highest dam in the world. It contains over 800,000 cubic yards of masonry, and so comes next to the Pyramids among masonry structures. Its great bulk is due to the fact that, owing to the rock on which it is built being rotten, the foundations had to be carried in places to a depth of 130 feet below the river-bed—that is to say, more than two-thirds of the entire mass is underground. Fifteen years were spent in its erection.

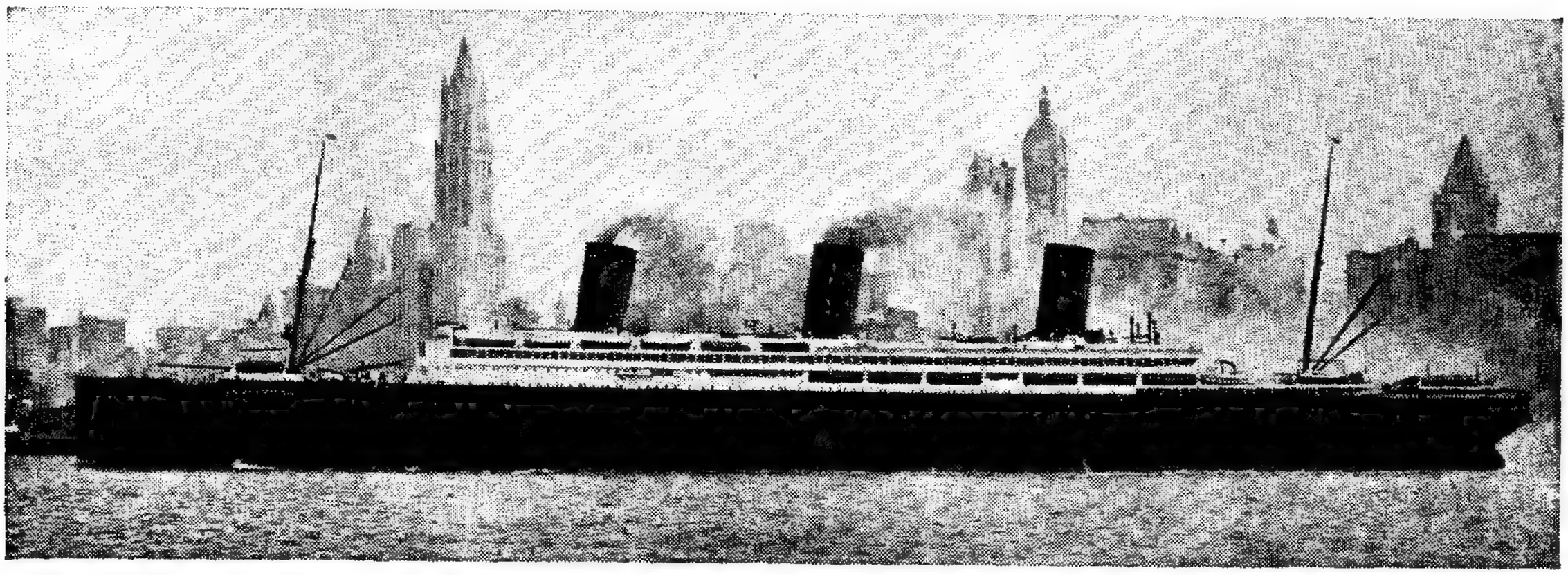
HAROLD J. SHEPSTONE, F.R.G.S.



[Fleet Agency.

THE BIGGEST BOOK IN THE WORLD.

This great Bible is 5 ft. 2 in. high and 3 ft. 6 in. wide. The contents are hand-written and were prepared by some 12,000 persons.



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THE "LEVIATHAN" SILHOUETTED AGAINST THE SKY-SCRAPERS OF NEW YORK.

Some Wonderful Buildings of To-day

THE great buildings of ancient and mediæval times described elsewhere in this book were built of stone and brick, and occasionally at first of wood. To-day few buildings of great size are wholly constructed of stone, although they may appear to be. The big modern building, whether town hall, hotel, bank, or insurance office, is really a great network of steel girders and joists. When hoisted into place and bolted together, the girders are covered with reinforced concrete—that is, concrete strengthened by a further network of steel or iron. In the first stages of construction, giant cranes, towering aloft, pick up the great steel beams and, swinging them high in the air, lower them gently into their places, to be dealt with by the riveters who close up the framework. The size of every steel girder to be used is estimated to an inch before a single one is placed in position, so that the structure may stand firm against weather and the vibrations caused by the traffic of a great city. In the initial planning, the wind-pressure on the walls has to be most carefully calculated, as well as the stress which each beam will have to bear under all conditions.

Men who work on the frames of these giant buildings, either in erection or repairing, must be strong-nerved, for they have often to hang literally between earth and sky, as is the case with the steeplejack

[*Topical.*

TOWER CROWNING THE NEW OFFICES OF THE PORT OF LONDON AUTHORITY.

is finished, the concrete workers begin their task, generally starting on the lower storeys while the girders of the upper part are still being put in place. Floors as well as walls are of reinforced concrete, so that the whole building shall be as fireproof as possible. In the well of each staircase is a lift shaft, and the world's highest buildings are fitted with nests of lifts, some for the lower and some for the upper floors. You may hear a lift attendant call —"Express, not stopping till the twentieth!" meaning that his lift will not take passengers for any of clinging to a stay between the great power-house chimneys shown in our picture. And often, when the day's work is done, one of these men will seat himself in the great hook at the end of a crane chain, so that the craneman may swing him to the ground and save him the trouble of walking down ladders. The man seated in the hook looks like a spider at the end of his thread as he swings.

When the steel framing

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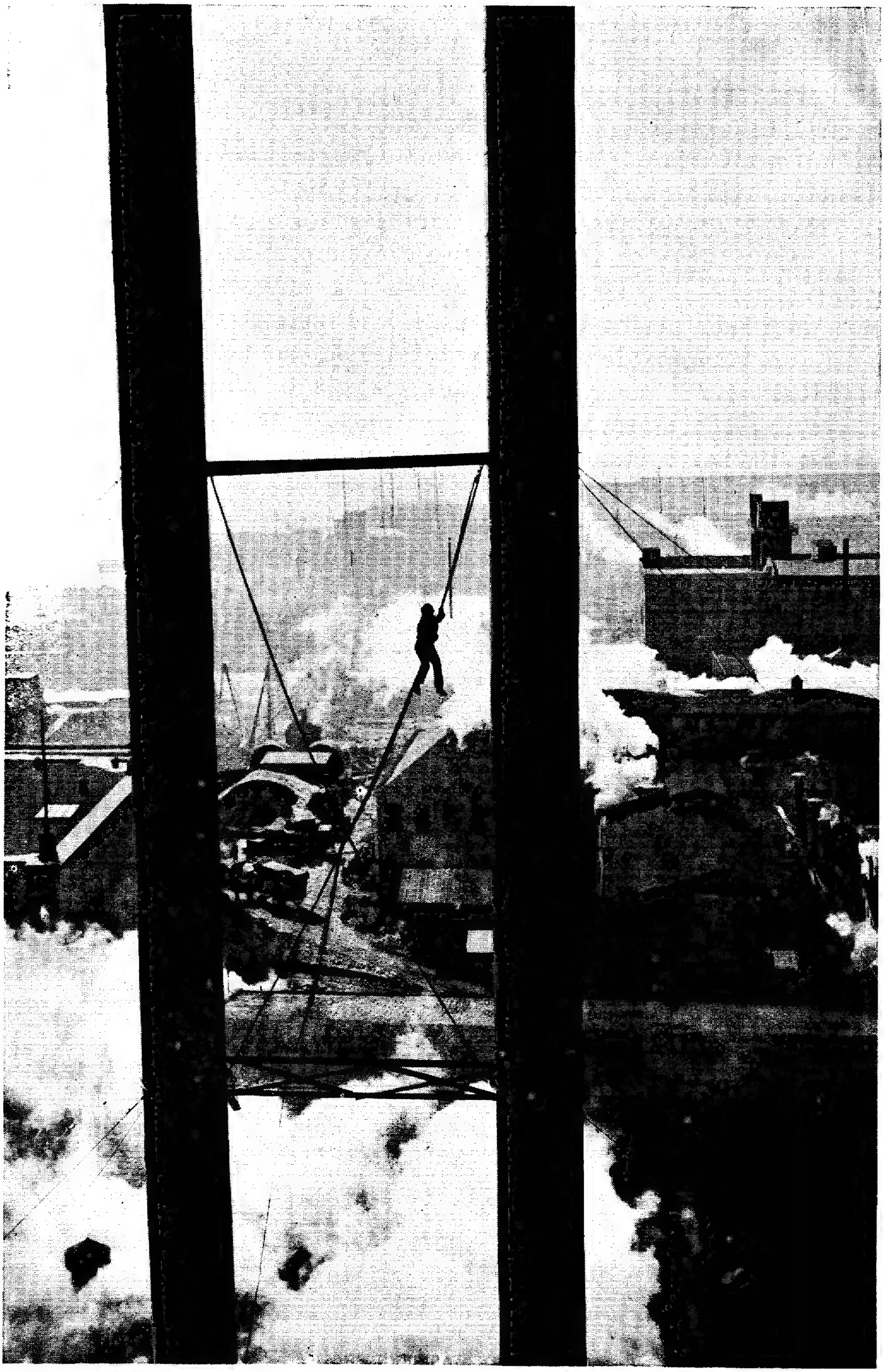
MASONIC TEMPLE, CHICAGO.



[*Underwood & Underwood.*

A STEEPLEJACK AT WORK ON THE SMOKE STACKS OF A LARGE POWER HOUSE.

the lower twenty storeys, but serves only those going above that level. It is like the guard of an express train for Liverpool calling out—"First stop, Crewe!" Then there are the slower "local" lifts for the lower ten storeys, and intermediate lifts for the middle floors.

New York is the principal city for "sky-scrapers," as great buildings of forty and even fifty storeys are called; the reason for this is that the city is built on a peninsula, and so cannot grow out on either side. As business develops, and more room is required for offices and homes, the only way to make room is by putting taller buildings on the same sites. Thus, the old building of five to ten storeys is pulled down, and one of thirty or forty storeys put in its place, so that the same amount of ground may accommodate three or four times as many people.

Quite a number of the famous sky-scrapers of New York are over forty storeys in height; some are over fifty. Each is a town in itself, having its own shops and flats; often a sky-scraper has its own water and electric light supply, together with an

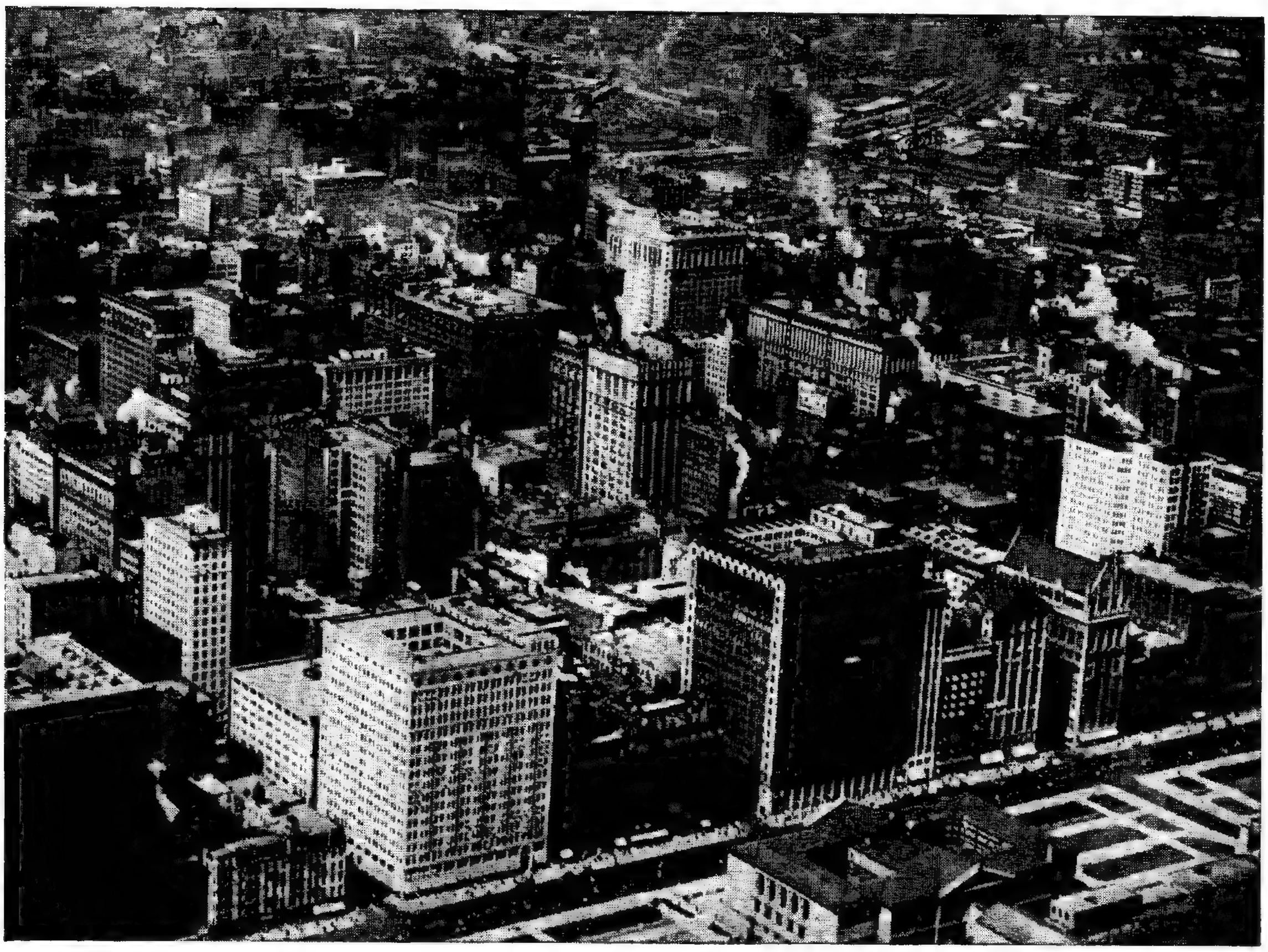
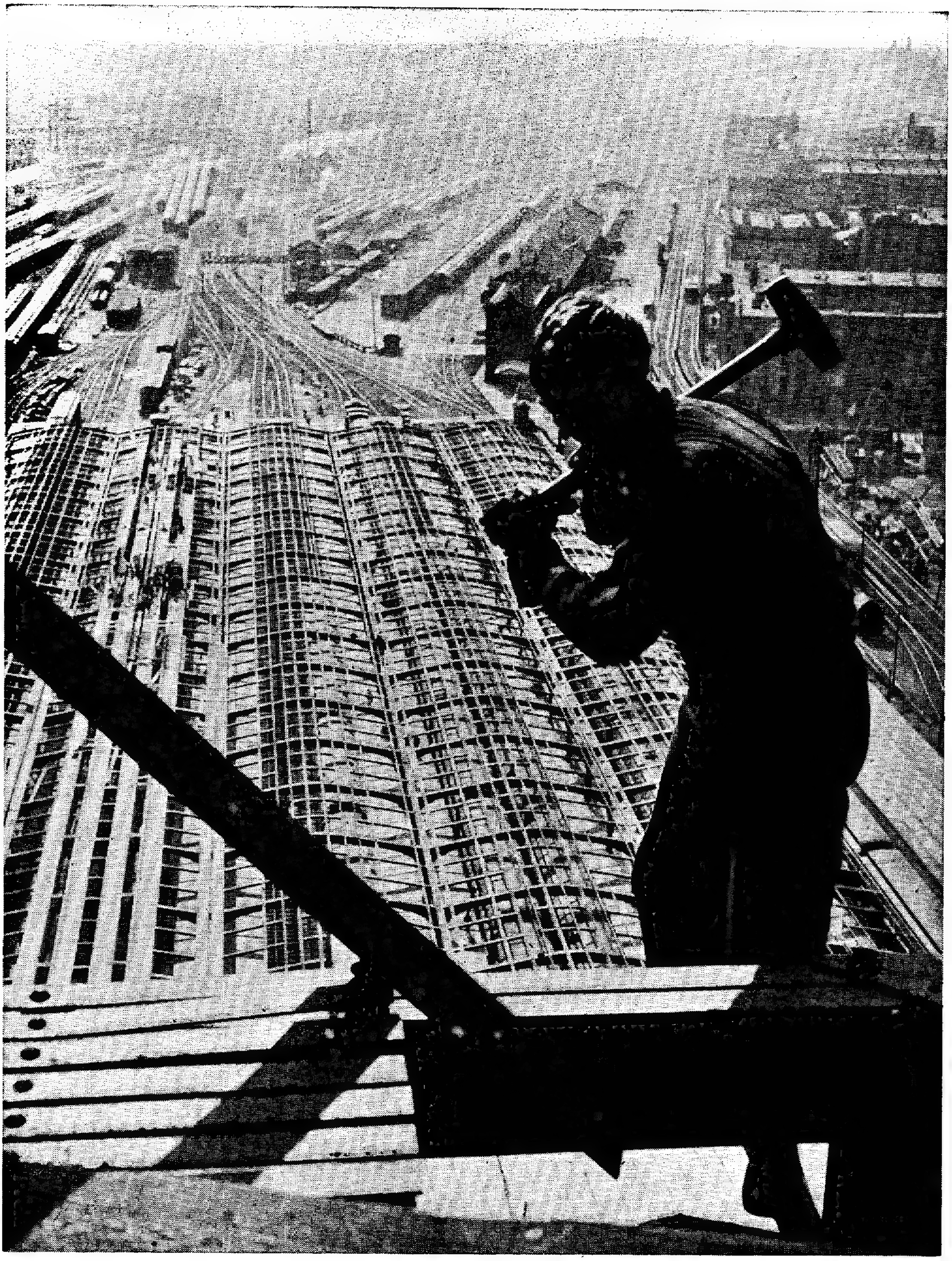


Photo U.S. Army Service,] *[Supplied by Topical,*

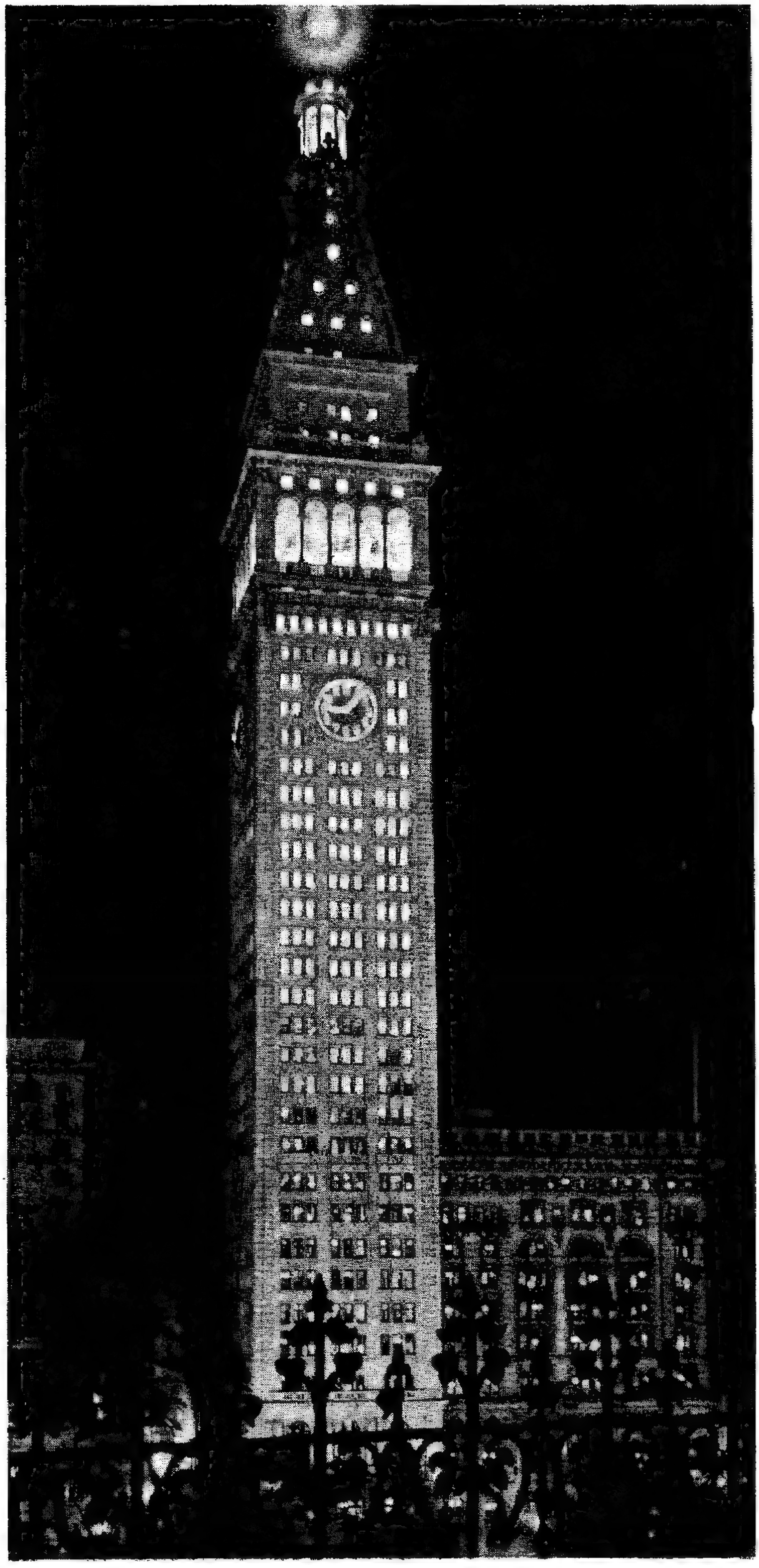
CHICAGO SKY-SCRAPERS, AS SEEN FROM AN AEROPLANE.



[*Underwood & Underwood.*

AT WORK ON THE FRAME OF A LOFTY MODERN BUILDING.

engine-room which supplies power as well as heat on all floors. Such a building will contain between two and three thousand rooms, with miles of corridors, and an entrance hall like a city square, with



[*Illustrations Bureau.*

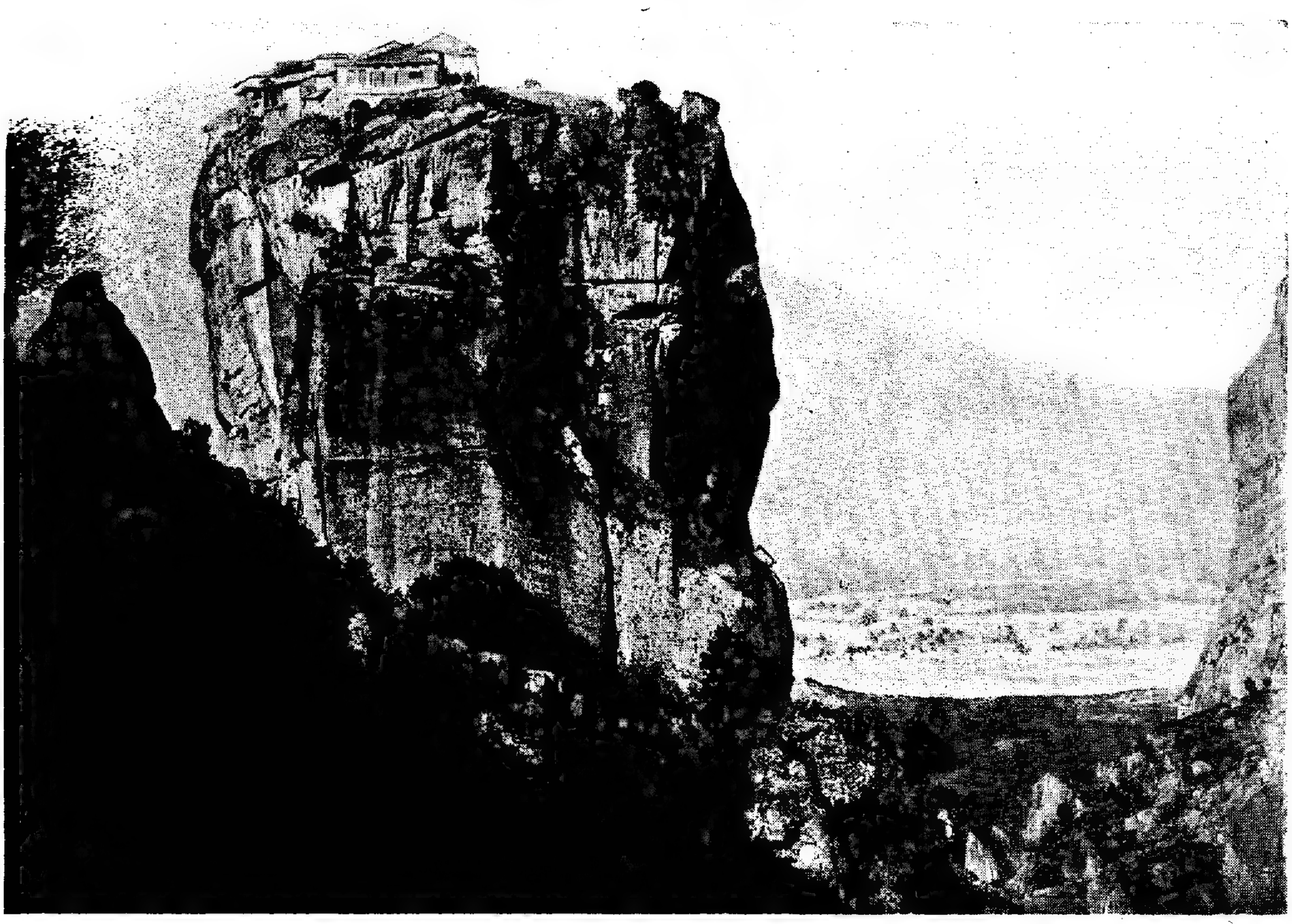
THE METROPOLITAN BUILDING, NEW YORK, ILLUMINATED.

shops and post-office and newspaper stalls ranged round it. Detroit, Chicago, and many other American cities contain blocks of such buildings rivalling those of New York.

The great cities of Europe have no need to erect such giant buildings, for they can usually expand on all sides as room is required. So far as London is concerned, a definite rule forbids the erection of buildings above a certain height, and there is good reason for this. Where a mammoth building is erected, finding room for thousands of people under one roof, there is certain to be congestion of traffic, no matter how wide the surrounding streets may be. Already the traffic of London is too great for its streets, and if the height of City buildings were doubled, say, it would mean that twice as much room would be required for traffic. London

would have to be planned all over again, and by the time the widening of streets in the central area had been undertaken to allow for the increase in traffic, there would be little saving in space.

Apart from mere height, which, as the pictures show, by no means renders a city beautiful, some of London's new buildings are among the most wonderful in the world. The huge London County Council building, fronting the Thames at Westminster, is a magnificent specimen of modern architecture, while the Port of London Authority building in Trinity Square, with its wonderful central tower and statue, is another splendid example of twentieth-century building. London, unlike New York, has room to expand; there are, actually in the City itself, still ranges of old three and four-storey buildings which can give place to modern steel-framed structures of eight and ten storeys, so that as yet there is no need to consider the erection of thirty-storey sky-scrapers, and the introduction of express lifts "not stopping below the twentieth."



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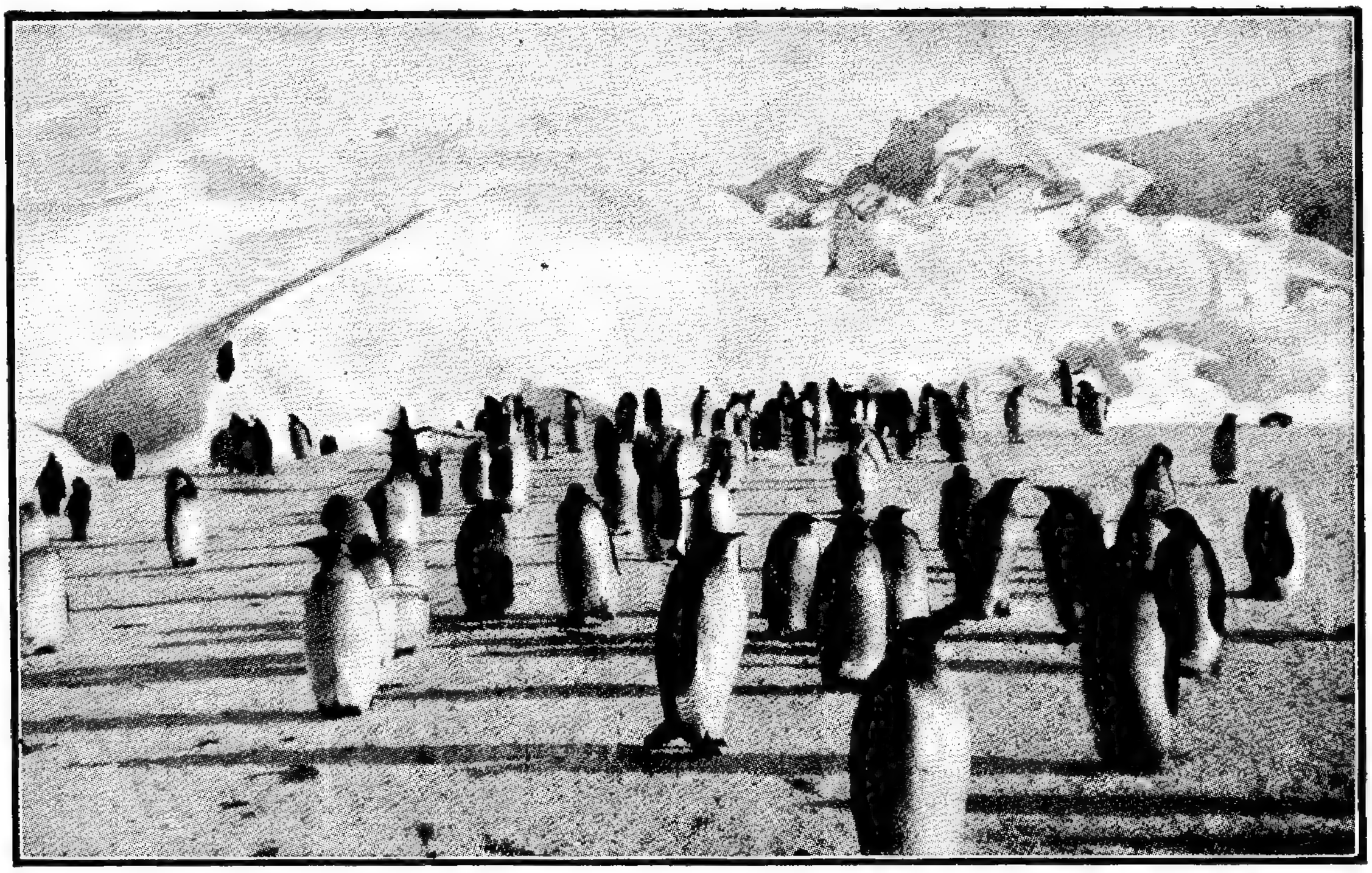
QUITE ANOTHER KIND OF "SKY-SCRAPER."

The Monastery of Meteora, in Thessaly, is perched aloft on an almost perpendicular crag. Access is by means of ropes and ladders.



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A ROOKERY OF EMPEROR PENGUINS ON ROSS ISLAND, IN THE ANTARCTIC.

The Wonderful Penguin People

PENGUINS are among the most wonderful and interesting of birds, and every Antarctic explorer, down to the late Sir Ernest Shackleton, has loved to describe them. Their quaint appearance and droll ways make them great favourites at the Zoo, but to be properly appreciated they must be seen in their native haunts, among the bergs and ice-floes. Although confined to the Southern Hemisphere, it is a mistake to think of them as living only in the coldest climates, for varieties are found off the coasts of South Africa, Australia, South America, and many of the southern islands.

Penguins are quite clearly birds of very ancient type, whose wings have become so altered through constant use in swimming that they resemble the flappers of the whale, the bones having become flattened. Penguins are indeed sailors to the manner born. On land they stand upright on their webbed feet, their thick legs appearing like jack-boots, and with their black backs and white waistcoats they present an almost human appearance. Their rookeries are as crowded as the bazaars of an Eastern city, the birds standing in long rows with "streets"

between. There are often tens of thousands in a single community, while a quite limited area will contain perhaps two millions. When man intrudes on their domains they at first show no fear, but only curiosity. Travellers sitting down in one of their colonies have known them to stroll up from behind and stand unconcernedly by their side, as friendly natives desirous, did they know how, of entering into conversation.

The feathers of the penguin are more like scales than true feathers. The birds have short, thick-set legs, and can walk and run very quickly. The Emperor Penguin of the Antarctic Seas stands 3 feet 6 inches high, and may weigh as much as 80 pounds. The King Penguin, found on Kerguelen Island, is almost as large.

The following account, by Professor Moseley, is typical of the experience of many explorers: "As we approached the shore, I was astonished at seeing a shoal of what looked like extremely active, very small, porpoises or dolphins. . . . They showed black above and white beneath, and came along in a shoal of fifty or more towards the shore at a rapid pace, by a series of successive leaps out of the water and leaps into it again. Splash, splash, went this marvellous shoal of animals, till they went splash through the surf on to the black, stony beach, and then struggled and jumped up amongst the boulders and revealed themselves as wet and dripping penguins."

The Cape Penguins are very fond of bathing, and stand in companies on the beach ducking and diving, just as children do at the seaside. These birds are sometimes known as Jackass Penguins, because they bray like a donkey. They are plentiful in the Falkland Islands, to which they go to breed towards the end of September, remaining till April. Their melancholy bray is continuous even at night. They nest among tussock grasses, under shelves of rocks and in burrows near the beach, either shallow or deep. Two white eggs are laid in October, but before long get stained. The rookeries in wet weather are like a morass, and many of the chicks quickly die. The adults at this time walk about in pairs, and are very shy, rushing into the water if surprised away from their burrows. Channels are made or left in the rookeries as water-runs, and there are main entrances for birds to enter and leave.

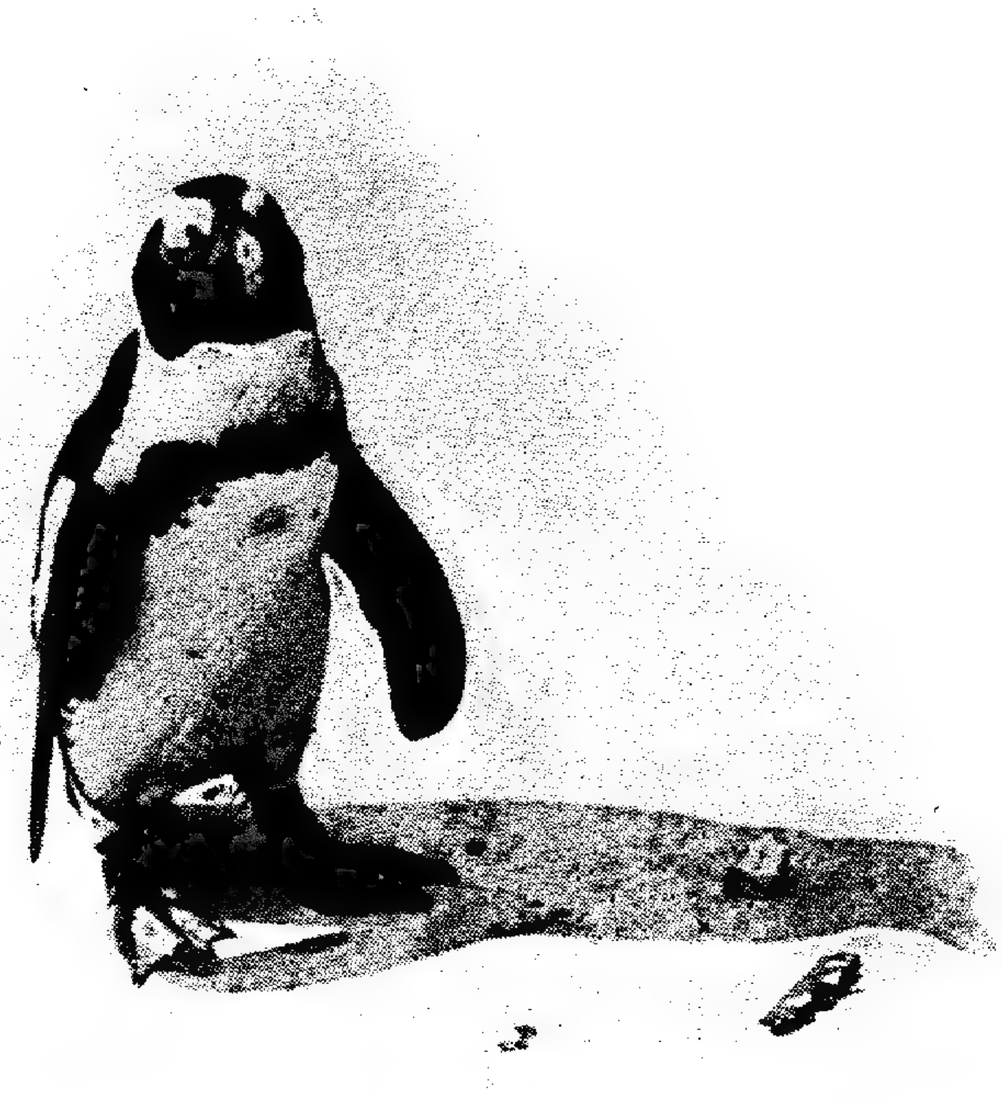
When fishing, and generally when on the sea, the penguin comes to the surface to breathe so unexpectedly, diving again almost instantly, that it is very easy to mistake it for a dolphin. One of the smallest

kinds, the Little Blue Penguin, which is only about 17 inches high, is extremely active. "Its swimming powers are so great that it stems the waves of the most turbulent seas with the utmost facility, and during the severest gale descends to the bottom, where, among beautiful beds of coral and forests of seaweed, it paddles about in search of crustaceans, small fish, and marine vegetables." Penguins live almost entirely on fish, which, owing to their agility in swimming and diving, they are readily able to capture under water, their paddle-like wings being used much in the same way as the fins of a fish.

Apart from their peculiar habits, what strikes one most about the penguin people is certainly the enormous size of their colonies. During the breeding season the birds assemble in tens of thousands, and are ranged in long lines like avenues of trees or ranks of soldiers, or one might perhaps better compare them to hosts of sailors, with black backs, and white tunics, and white drill trousers turned up over short black leggings.

With this curious make-up it is no wonder that the toy penguin is so popular in human nurseries.

A. R. HORWOOD.



[*Topical.*

CAPE OR BLACKFOOTED PENGUIN.

A PENGUIN "ROOKERY."

Penguins, like human beings, live together in great communities, which sometimes number tens of thousands. They are splendid swimmers, and may often be seen standing in companies at the water's edge, like children at the seaside waiting their turn to bathe.

[*Press Exclusives.*

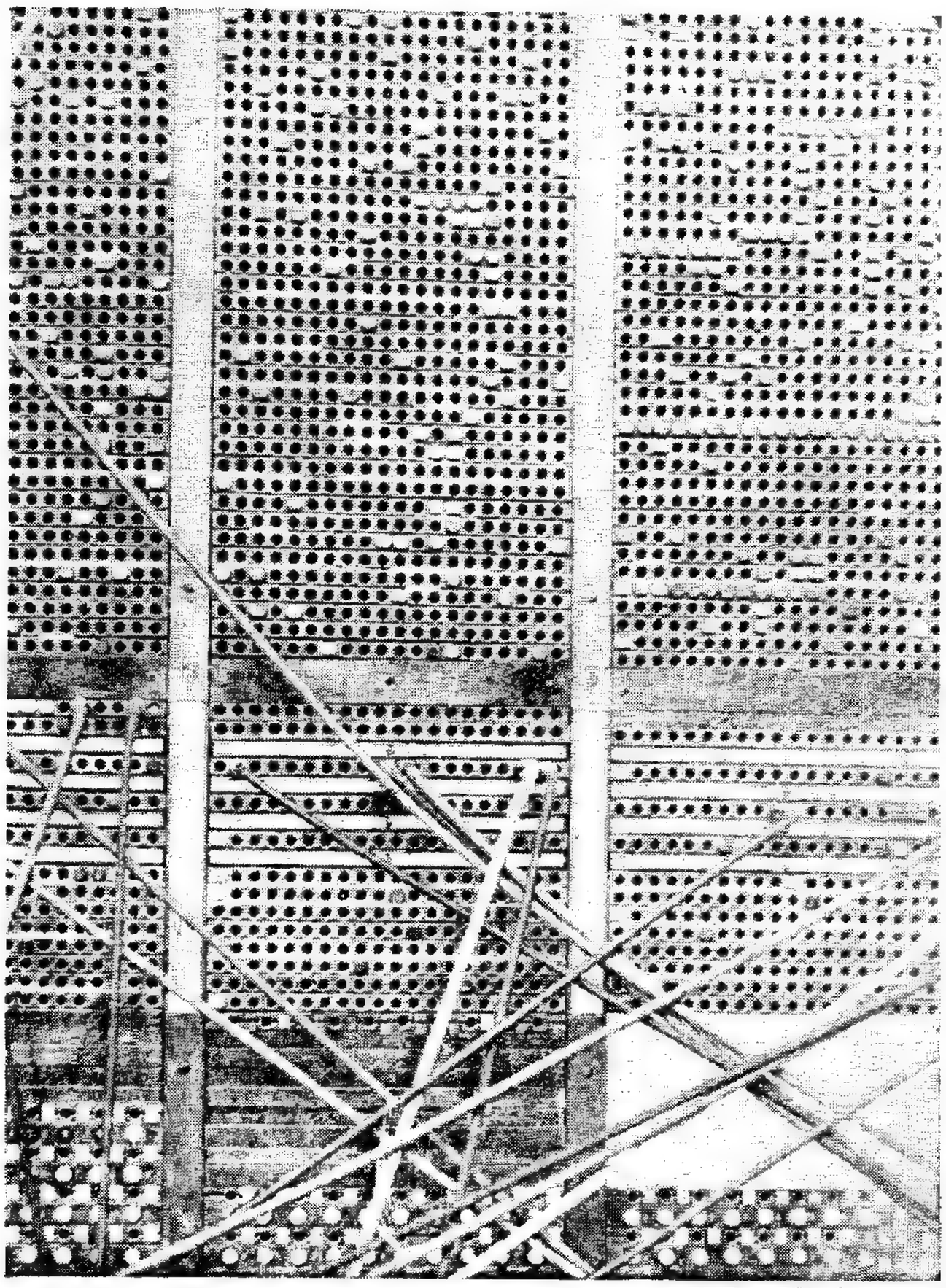
CONTROLLING TUBE TRAINS BY TELEPHONE.
The movements of every train are automatically reported.

Wonders of the Telephone

YOU probably know that your telephone wire (or your daddy's) ends inside a little hole in a great board at the "Exchange." As soon as you take off your receiver to make a call, a light shows the operator that your line needs attention, and she pushes a metal plug into the hole in which your wire ends. This enables her to hear you talking; you give her the number to which you wish to speak, and she takes up another plug, fitting it into a little hole corresponding to that number; then she rings up the required number, the other receiver is taken off, and you can talk to the subscriber whose exchange and number you gave.

Meanwhile, on another board, as soon as the connection you want is fully made, a little dial like a cyclometer on a bicycle adds one to your total of calls, so that, when your bill is made out, the exact number of calls you have made during the month, or quarter, is read off the dial and entered on your bill.

This all sounds very simple, but there is a wonderful complexity of electrical mechanism behind it. The process described refers only to one wire, but wires by the thousand enter every telephone exchange, and there are scores of operators, each dealing with her own little group of numbers, connecting with the different exchanges; there are



[*Press Exclusives.*

PLUG HOLES AT A TELEPHONE EXCHANGE.

Each plug hole represents a subscriber's number. They are arranged in multiples, so that by glancing up and along the operator can quickly pick out the number she wants. The wires seen are those connecting subscribers who are in the act of conversing.

the supervisors, ensuring that the work is done correctly and swiftly (the operator can only give about ten seconds to each incoming call); and there is the army of mechanics constantly repairing and testing lines. The lines entering an exchange are bunched in great masses of four to six hundred pairs, as shown in the photograph, and led off from the bunch to their separate slots on the exchange board. The lines are liable to be affected by weather, especially thundery weather, so that mechanics must always be at hand, both in the exchange and along the "mains," or tunnels, in the streets along which the wires run from exchange to exchange and to business and private houses, each of which has a separate wire.

Then there is the "trunk" system, connecting one town with another, so that it is possible to sit at a table in London and talk to a man in Birmingham or Manchester. "Trunks" is a separate department; you call up the "trunk number," and have to take your turn on the set of wires connecting two towns, for it is not possible to run a separate line for each subscriber in a distant town, and these wires are busy all day long, while at night they are busy with "press" messages and similar matters. The process is the same as in that of the local call, except that you have to wait your turn to use the "trunk line."

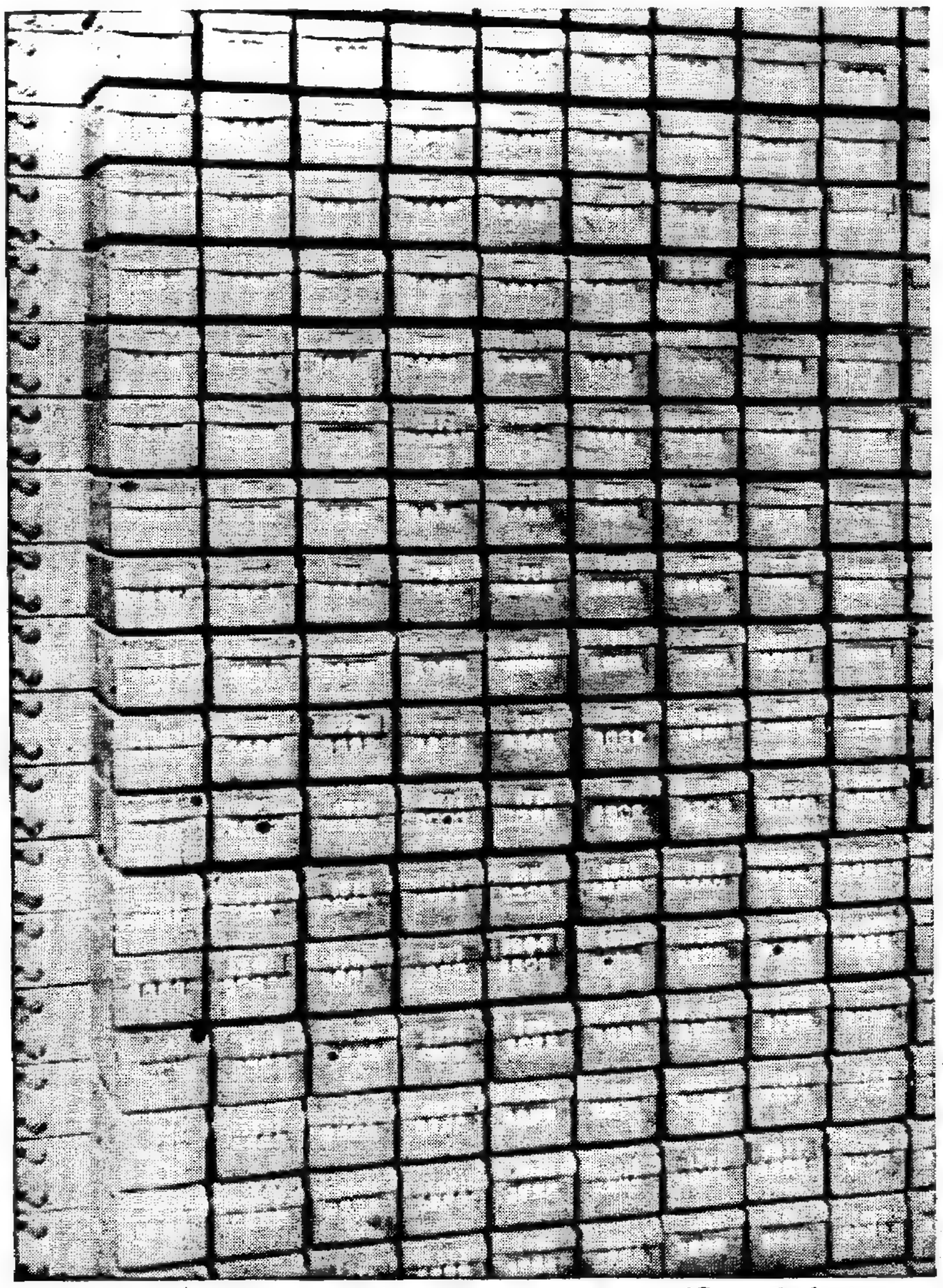
The "automatic" telephone is an adaptation which enables you to call your own numbers without the aid of an operator at the ex-

change. It is a wonderful electrical device operated by a numbered and lettered disc on the transmitting instrument, and in addition to saving time it ensures absolute secrecy and prevents the annoyance of wrong numbers being given. Many automatic telephone exchanges are now being opened.

Long before the present days of broadcast wireless concerts it was possible by means of an adaptation of the telephone for a score or more of people to sit in a room in London, say, and quite easily listen to a concert which was being given in Manchester, special instruments being installed in order to catch the voices of the performers and to reproduce the sounds on a specially loud scale.

Another remarkable appliance, known as the optophone, produces in a telephone receiver a series of musical notes representing letters as the instrument travels over a printed page. By this device blind persons can be taught a quick and easy way of reading printed matter, a speed of thirty words a minute having been found possible. This is far quicker than reading the Braille raised type for the blind, and it does not necessitate the use of special paper and type, as does the Braille method.

There is a form of electrically operated telephone in use in factories where high temperatures are dangerous. This instrument does not talk in the ordinary way, but if the temperature in a room gets beyond a certain point, it



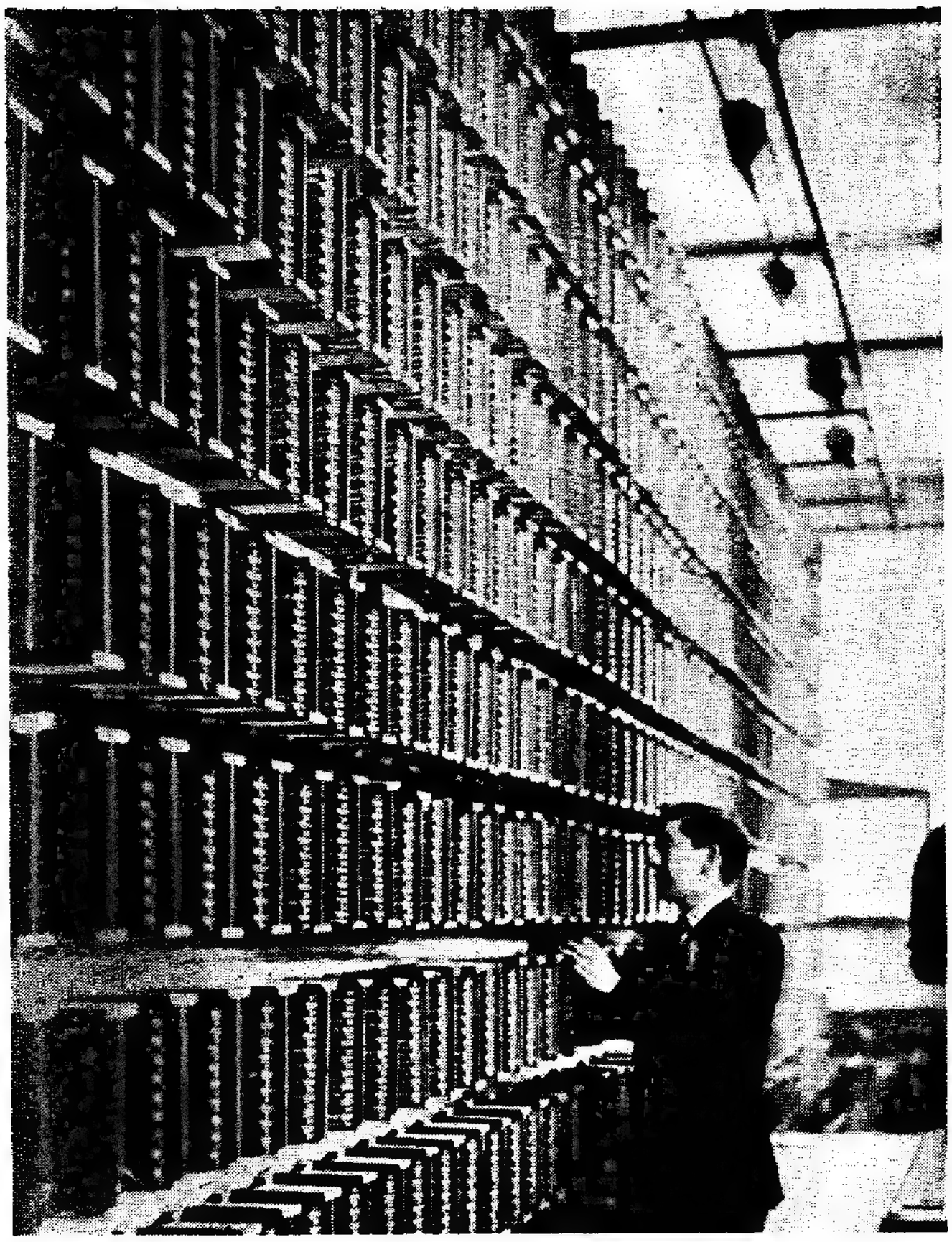
[*Press Exclusives.*

TELEPHONE TALLIES.

As subscribers are now charged according to the number of calls, each has a tally, which automatically adds one to the record whenever a call is made. At a busy exchange there may be thousands of these tallies.

sets a bell or a sort of fog-horn blowing a warning to employees to get to safety at once. An even more wonderful appliance immediately on an outbreak of fire automatically telephones in loud tones to all parts of the building involved, announcing the position of the fire and the safest means of escape.

Another form of automatic telephone is used on tube railways; the operator, sitting at a board, is able to tell the movement of every train on the system by means of automatic reporting instruments, and it performs other little auxiliary services; by its use a breakdown is known at headquarters almost before the rear guard of the train knows what has happened. The wonderful efficiency and speed of the tube railway services is largely due to the fact that the movements of every train can be so readily controlled from a central point.



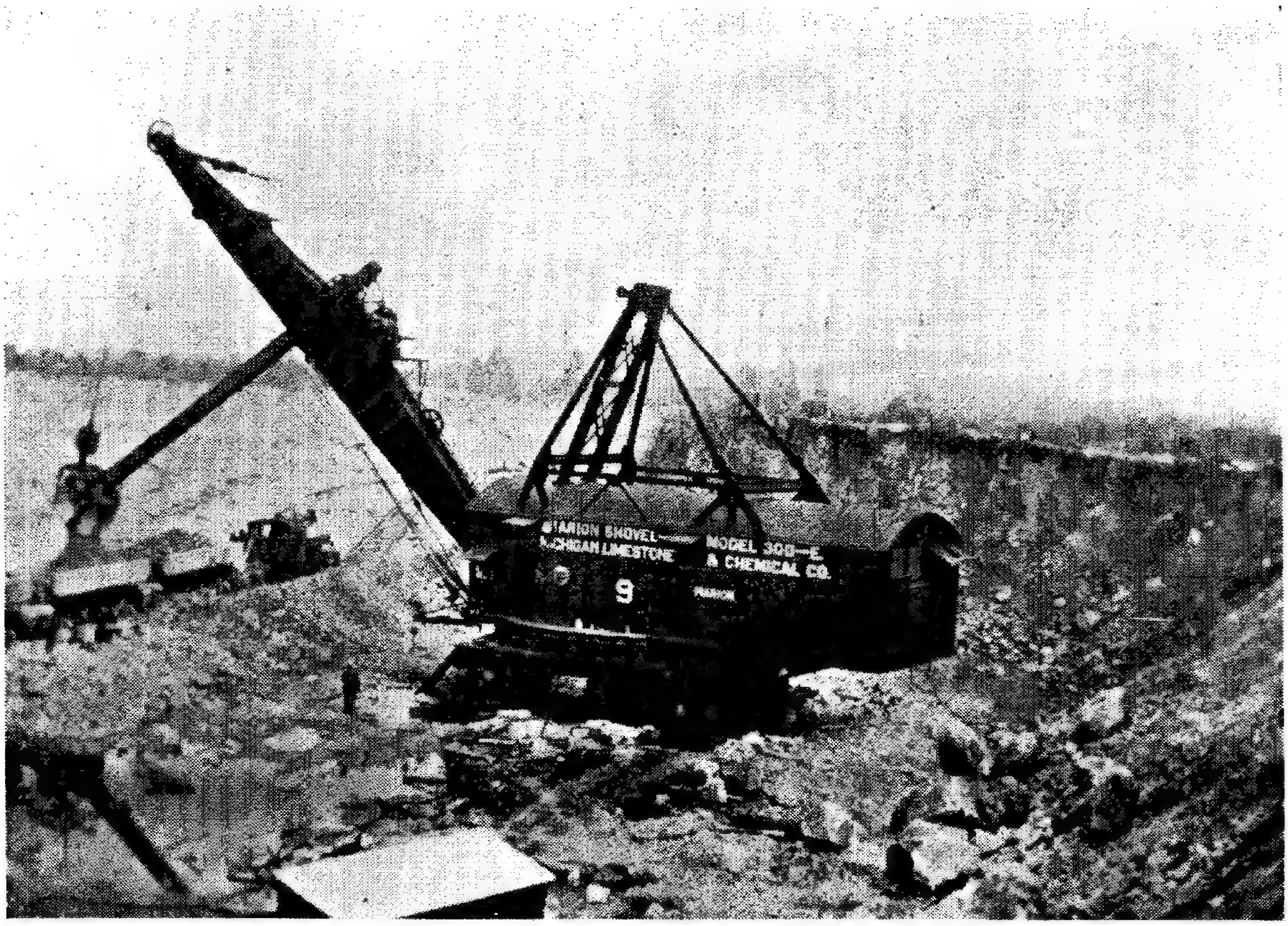
[*Press Exclusives.*

ONE OF THE GALLERIES WHERE THE WIRES ENTER.

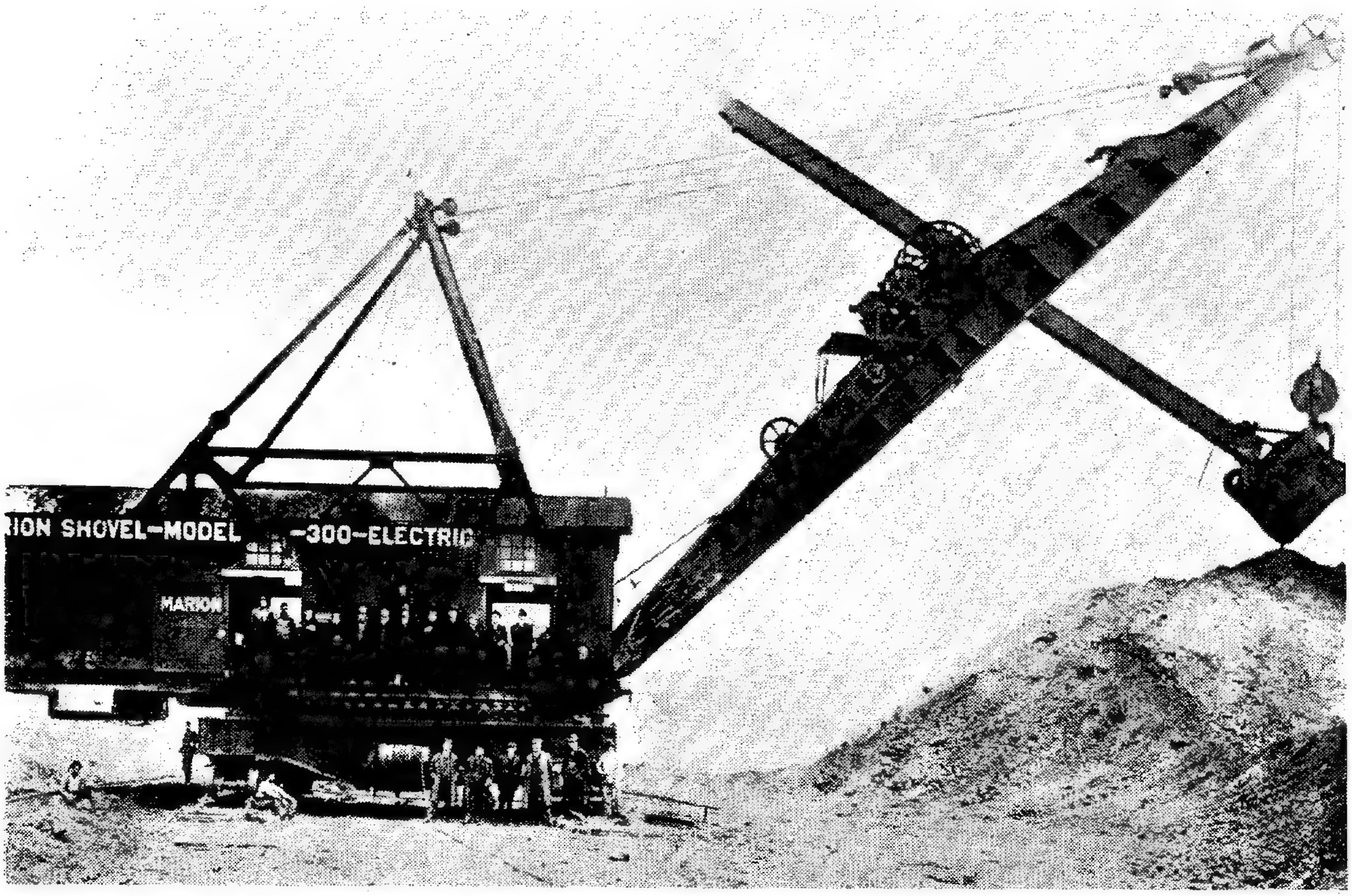
In case of mishap or breakdown the faulty wire can at once be traced and a "cure" effected.

AN AUTOMATIC TELEPHONE.

With this instrument the subscriber himself gets the number he requires.

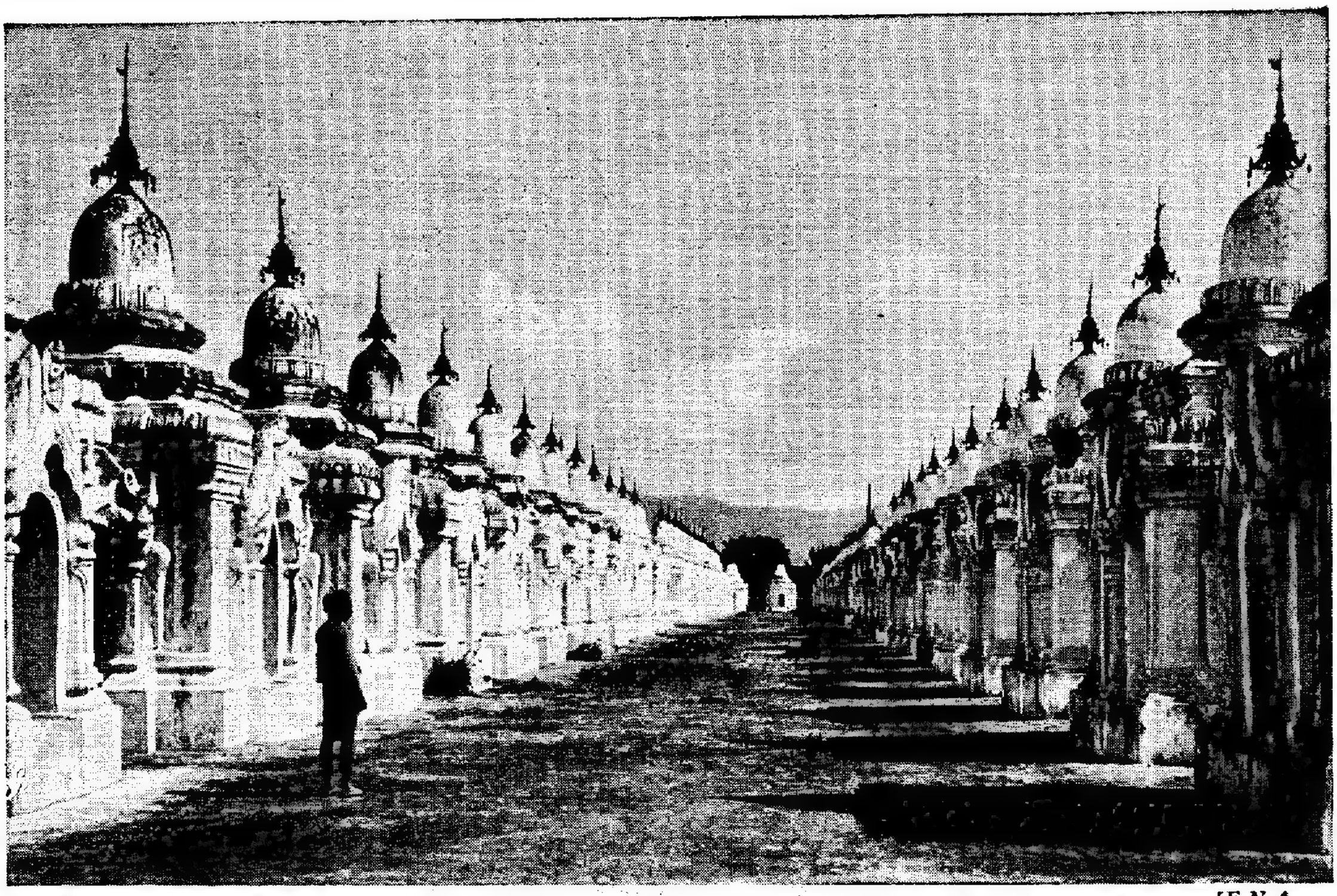


A 300 TON ELECTRIC SHOVEL WORKING IN A LIMESTONE QUARRY.



By courtesy of the] [*General Electric Company, Schenectady, New York.*

A 300 TON ELECTRIC COAL STRIPPING SHOVEL, WITH DIPPER HOLDING 8 CUBIC YARDS.



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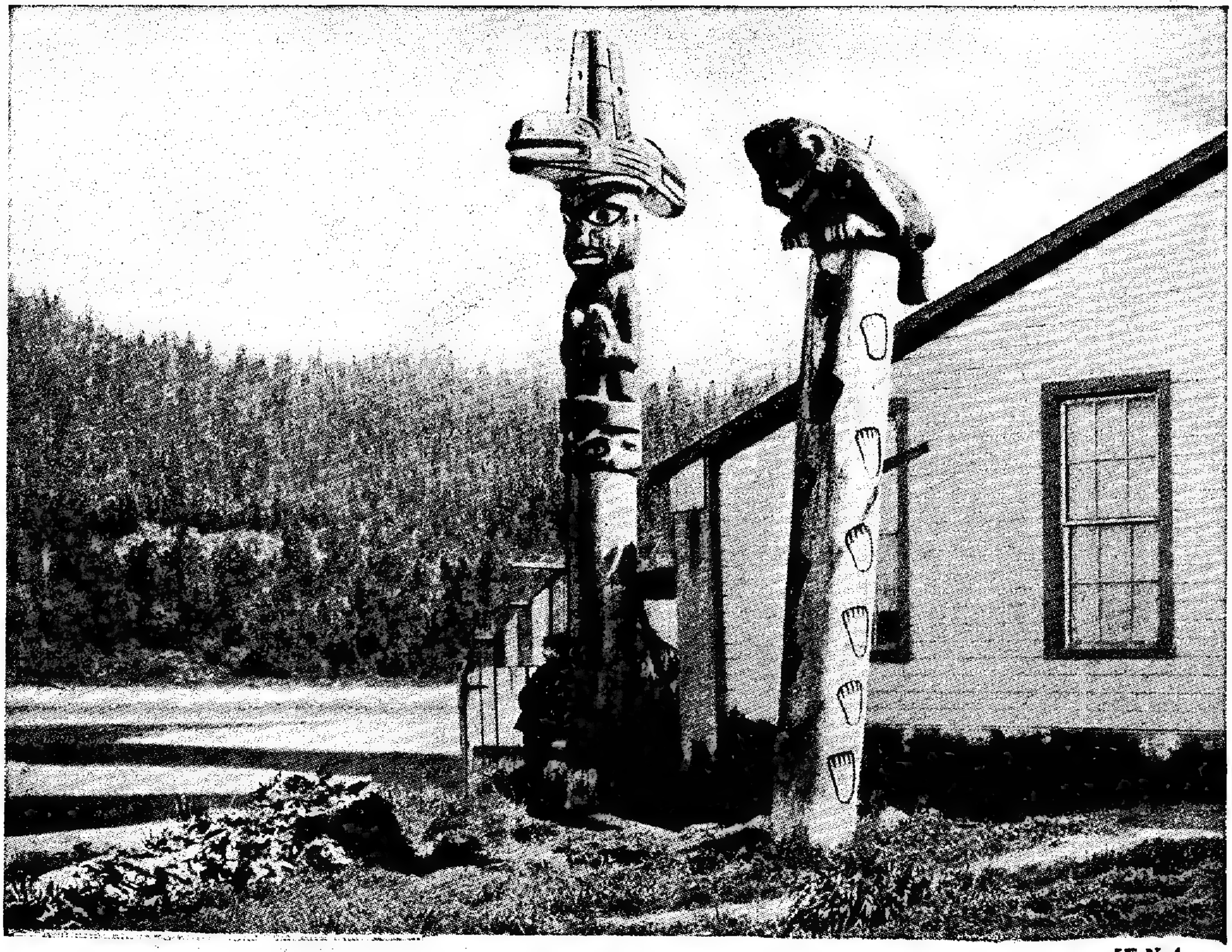
PAGODAS, MANDALAY.

Avenue of 729 pagodas, each of which contains a chapter of the Pali Bible, carved on alabaster.



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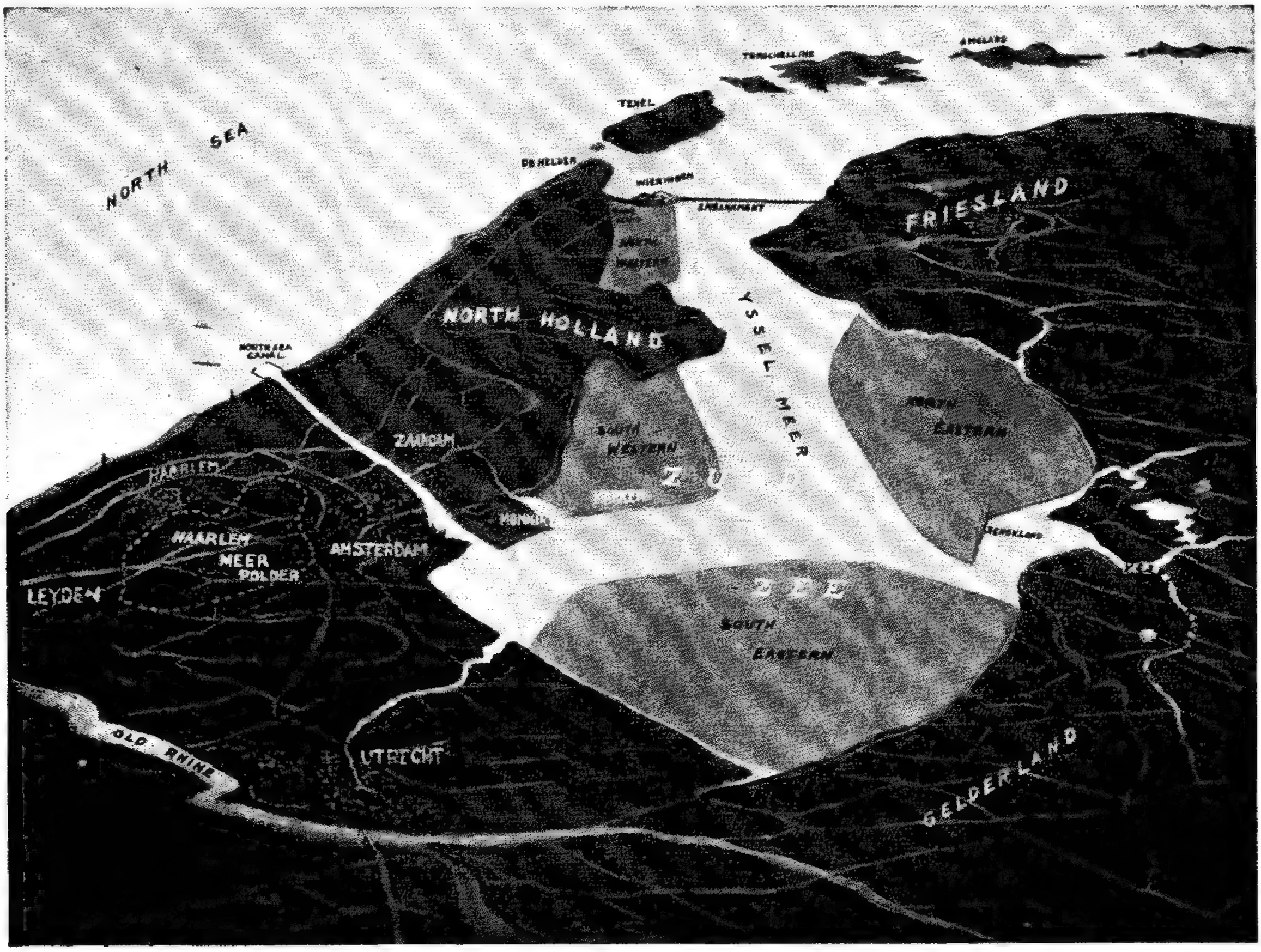
TOTEM POLES, ALASKA.

(See note on page 12.)

Reclaiming the Zuider Zee

ABOUT seven hundred years ago a great storm swept the coast of Holland. All along the shore were barriers of earth and sand designed to protect the low-lying lands from the fury of the waves, but at certain points those walls were unable to withstand the attack and the water poured in on to the smiling farmlands until an area as large as the county of Norfolk was converted into an inland sea. Only



The sections in lighter tint show the 530,000 acres of land which are to be reclaimed when the great embankment is finished.

a few days before, eighty thousand people had been living happily where now the waters spread; they were all drowned, and hardly a trace remained of the hundred or more villages in which they had dwelt.

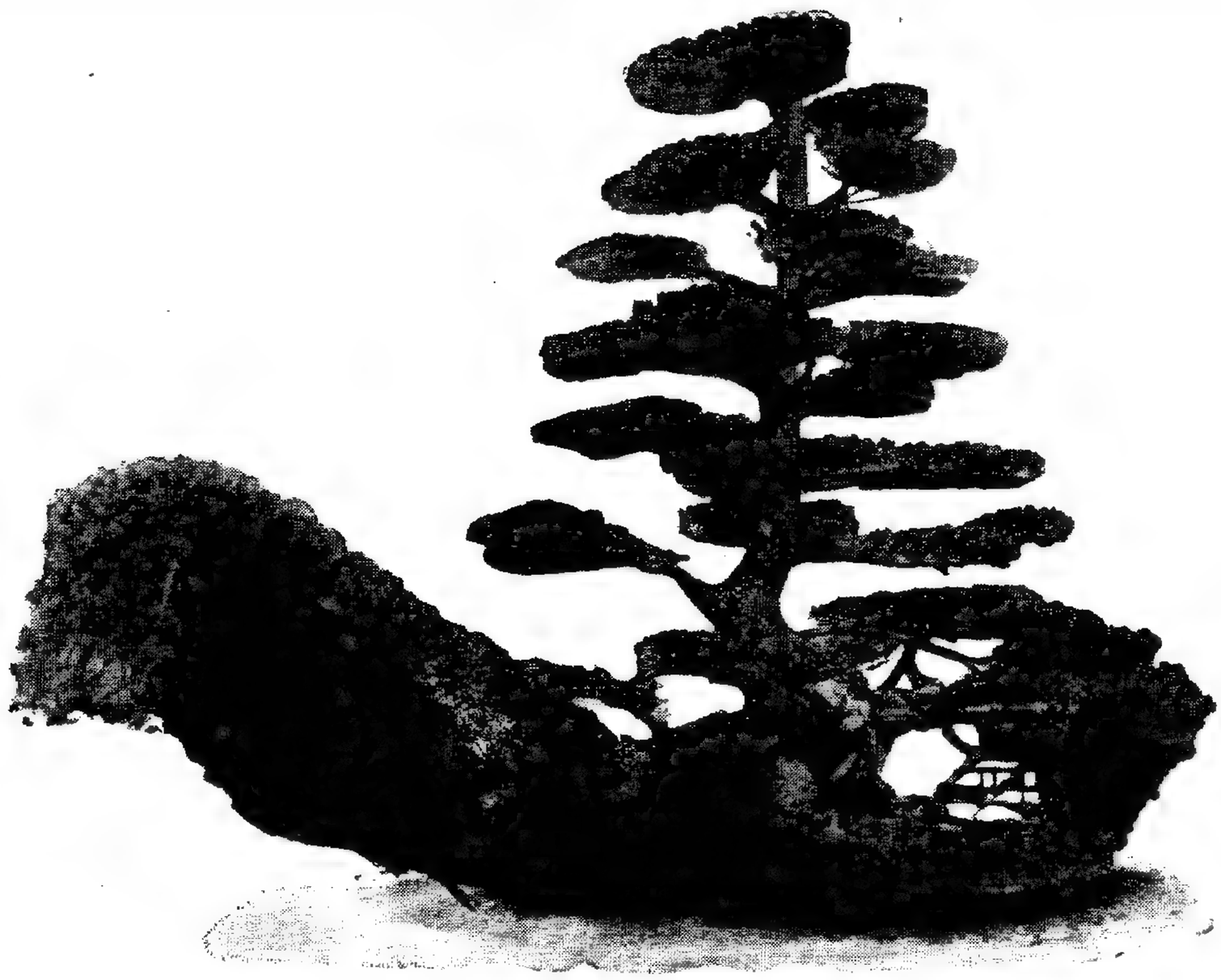
Many times it has been proposed to wrest back all this land from the sea, and now at last the first part of a wonderful scheme has been put in hand. Across the mouth of the Zuider Zee is being built a

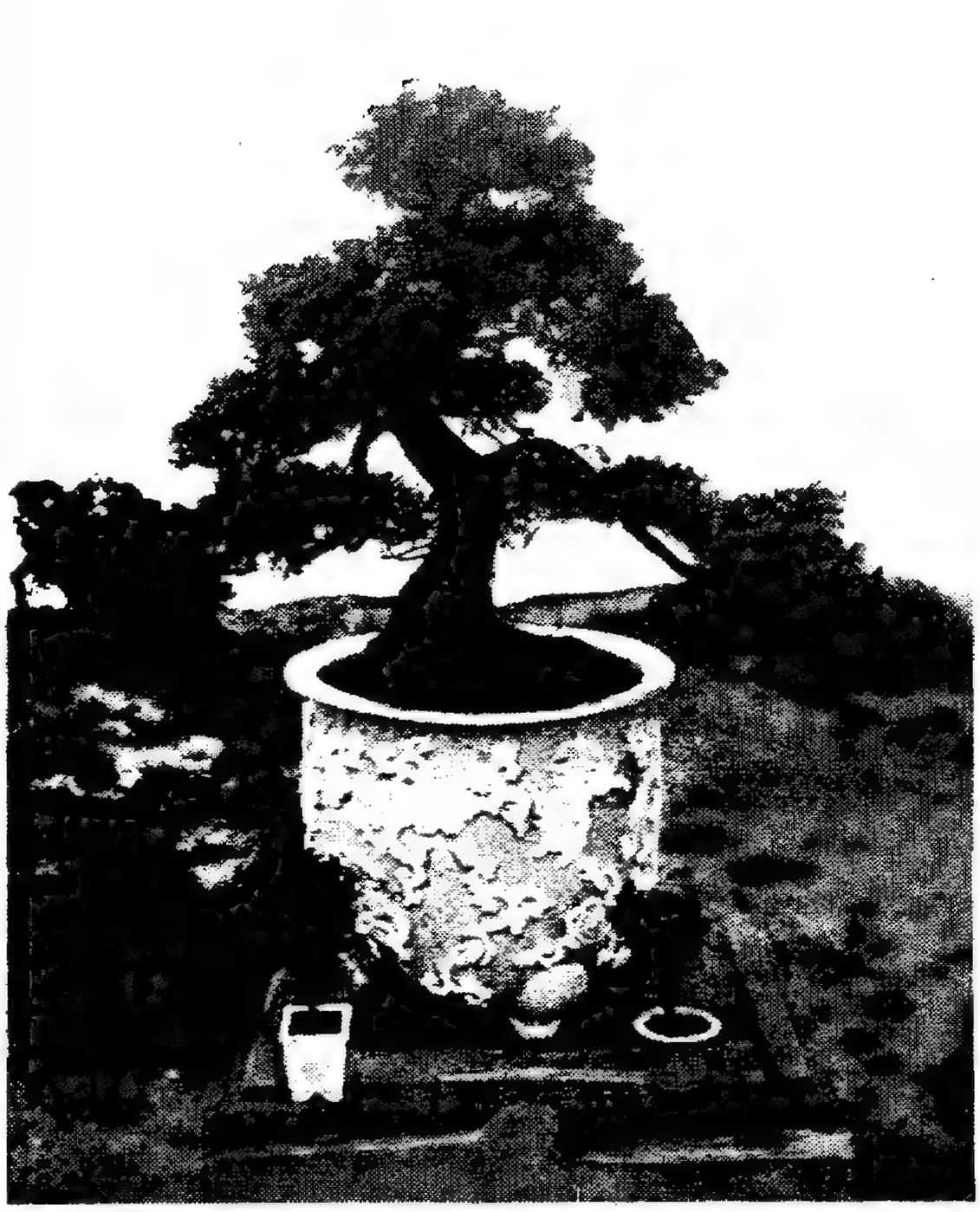
great embankment, some fifteen miles long and pierced with thirty-three sluices and two locks for ships. Along this embankment will run much-needed railway and road communication between North Holland and Friesland; for when the sea broke in and formed the Zuider Zee it almost cut Holland into two, so that farm carts which had passed from one village to another in a few hours had to spend days on the journey and to skirt the great waste of water.

In addition to the embankment, there are to be built four great walls, enclosing the shaded areas shown in the diagram. As these are made, the waters covering the enclosed land will be drained off and in time the land will become dry enough to be used for farming and other purposes. Though these changes are hardly likely to be finished in time to alter your geography lessons, probably when your children are old enough to go to school they will have to learn that the Zuider Zee, instead of being a great square of blue in the middle of Holland, has shrunk to a couple of strips forming, roughly, the letter T upside down.

The "Little Trees" of Japan

IN striking contrast to the giant Redwoods, or "Big Trees," described on another page, are the miniature trees of Japan. These are not "baby trees," but grown ones which have been dwarfed by special treatment through a great number of years. Thus an oak, a maple, or a pine which, if left to Nature, would have been an ordinary tree has become in the hands of Japanese gardeners a pot plant, perfect in all its proportions, but only a foot or two high, even though it may be several hundred years old. The exact process is a secret, but we know, roughly, that when a seed or cutting is planted it is starved in poor shallow earth, and the tips of its growing roots and branches are continually cut off. This treatment is continued by generations of gardeners until we get the fascinating, if rather mournful, little trees of to-day, a forest of which would grow in a drawing-room. Often, too, the gardeners train the trees so that their form expresses some idea—a dragon ascending to heaven is, for instance, a favourite one.





[*Photographs by Clarke & Hyde and Special Press.*

JAPANESE PIGMY TREES.

1. A tree shaped as a junk. 2. A century-old tree which is only two feet high. 3. Sixty years old and only eighteen inches high.

Special Press.

THE LARGEST TYPE OF MONOPLANE IN THE WORLD.

For some years it has seemed that monoplanes would be entirely superseded by biplanes. This powerful machine, however, can carry twelve passengers at a speed of 120 miles per hour. It has a 450 Napier "Lion" engine. The cabin is entirely enclosed.

Wonders of the Air

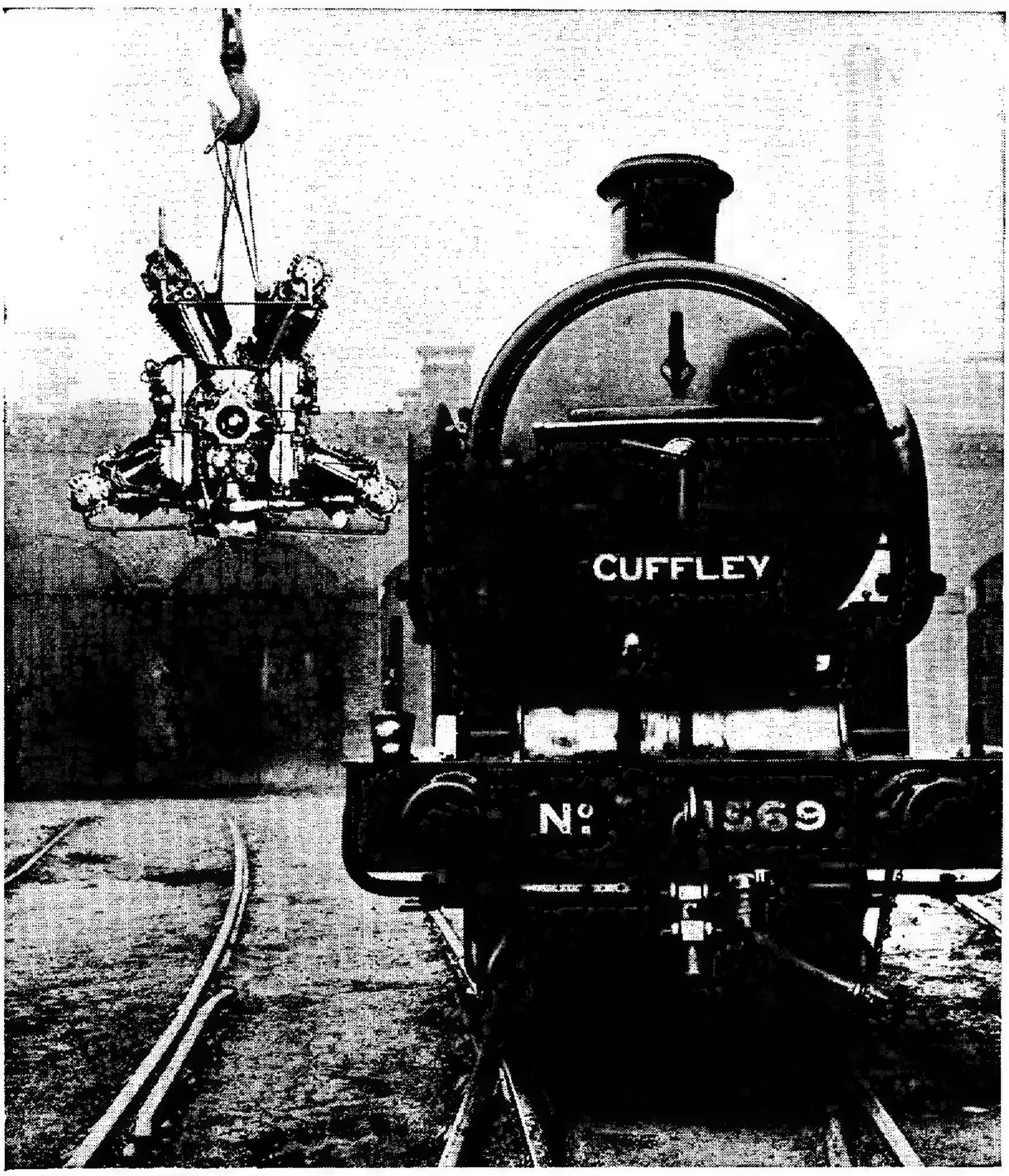
ALTHOUGH for a period after the War but little interest seemed to be taken in aviation, it is a mistake to think that no progress is being made. Air routes are being developed in many countries, and all over the world clever engineers are giving time and thought to the problems yet to be solved before air travel will become as general as road or rail locomotion.

A few years ago, there was much argument among experts as to whether it was safe to put fifty horse-power into an aeroplane; the "Green" engine had just been produced, and there was doubt whether it was wise to use so much power, and still more doubt whether it was safe.

The aeroplane engine of to-day is twenty times more powerful than that "Green" engine. Our photograph showing a little aero engine slung beside a great railway locomotive is that of two engines of exactly the same capacity; the aero engine develops 1,000 horse-power, and so does the railway locomotive. Naturally, the aero engine would be useless for railway work, for heavy weight is necessary to make the engine wheels grip the rails; in aero engine construction the weight has been got down to as low as a pound per horse-power. In

the days of the " Green " engine, it was nearer three pounds, and this marvellous advance in construction has been accomplished in less than ten years.

In many other ways flying has made great advances in recent years. An all-metal propeller has been satisfactorily introduced ;



[*Special Press.*

EQUALS IN POWER.

The tiny Napier " cub " aero engine, weighing about 1,700 lbs., develops 1,000 horse-power, equal to that of a great locomotive weighing seventy tons.

propellers made of laminations, or layers of wood, glued together under enormous pressure, are still used, but exposure to water, use in damp climates, and undue strain in use, warp and destroy these wooden propellers very quickly. It is estimated that in tropical countries the " flying life " of a wooden propeller is not more than twenty hours at the most—that is, the propeller can only be actually used for twenty

[*Central Press.*

A FLOATING MAIL BAG.

Airman with non-sinkable and waterproof mail bag that has been recovered from the sea after being dropped from a height of 300 feet.

hours in the air. Early attempts at producing a metal propeller resulted in failure; when these propellers were spun at high speeds they shattered themselves at once, owing to the vibration and to the pull on the blades. With the new form of all-metal propeller these troubles have been overcome, and such propellers last indefinitely.

Another feature of modern aeroplane construction is that the graceful monoplane is coming back. "Streamlining" has led to a thickening of the wings of aeroplanes, and it has been found possible to "stay" single wings to large bodies so as to give the necessary strength without going to the

[*Central Press.*

THE OCEAN POST.

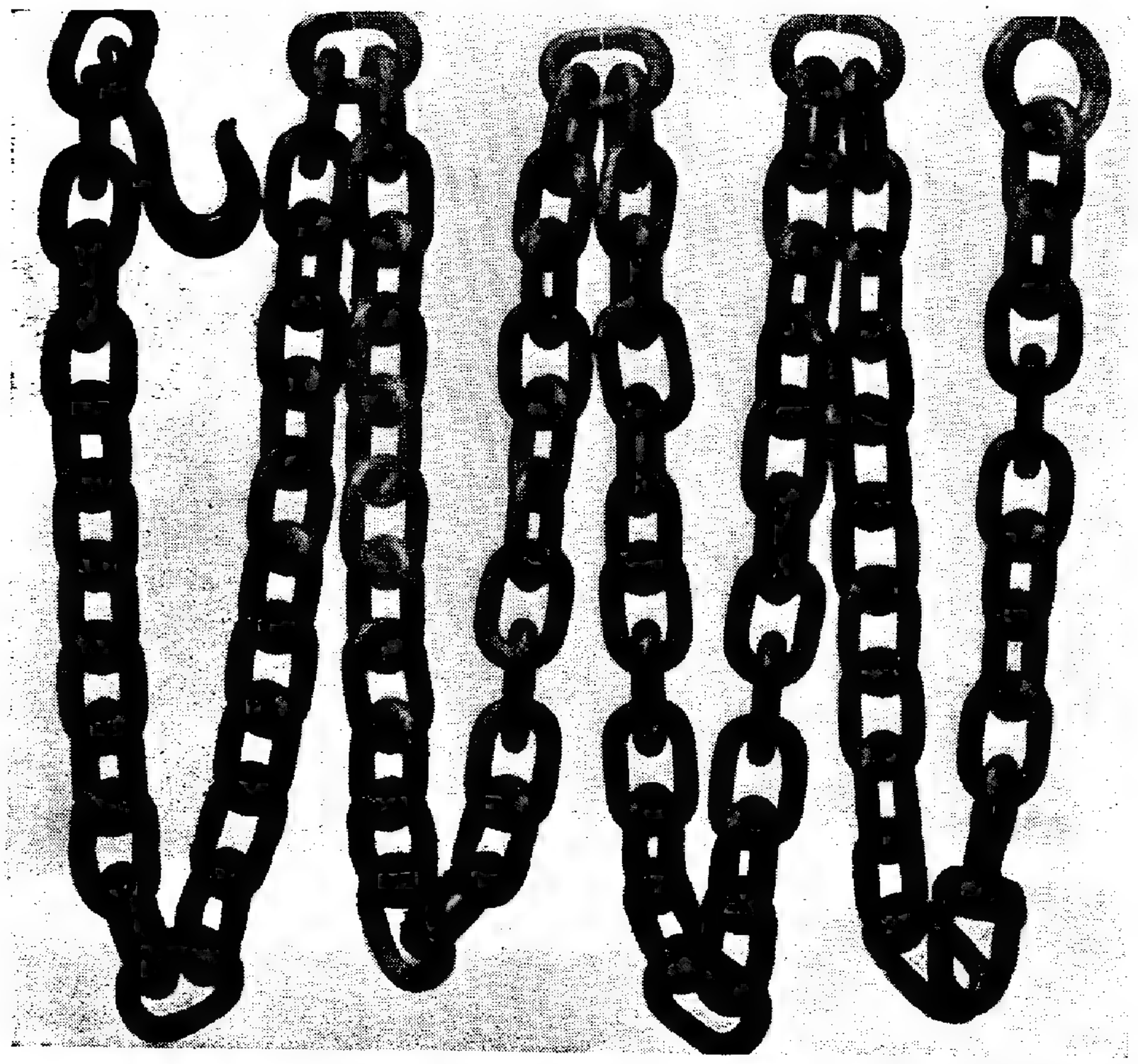
Mails are now quite frequently dropped from aeroplanes into the water and picked up, so that the machine does not have to stop. The man is wearing a non-sinkable suit, and the mail bag is also non-sinkable and waterproof.

expense of twin wings placed one above the other. Monoplane machines are now used on passenger services, carrying as many as twelve passengers, with their baggage. Air mail services are being rendered more safe and reliable by the use of unsinkable mail bags; instead of a machine stopping at stations on its route for the delivery of mails, the bags are dropped from the machine into water, where they float and are fished out while the machine goes on its way without loss of time.

Flying-boats, too, have made great advances; the earlier patterns took little account of the comfort of those they carried, but the flying-boat of to-day is an enclosed vehicle in which pilot and passengers sit in comfort, sheltered from flying spray while at the water level, and screened from draught and chill while in the air.

The greatest advance of all, the perfecting of the helicopter, enabling a machine to rise and descend vertically, is practically accomplished, though no particulars have been made public. The helicopter will solve the problem of landing in small spaces, and the machine will be able to "hover" in the air when required, just like a gas-filled airship.

E. CHARLES VIVIAN.



H. J. Shepstone.

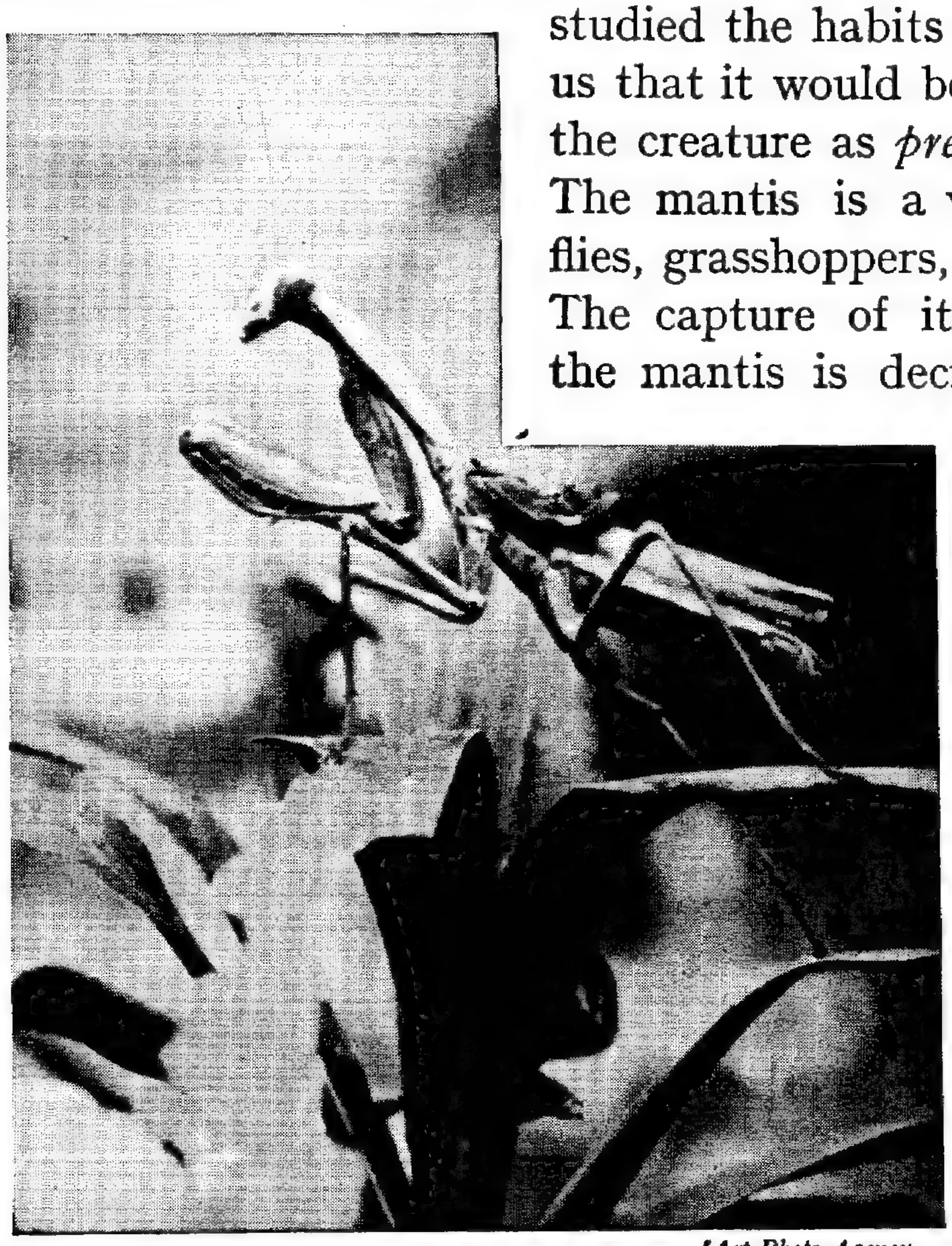
COULD YOU MAKE THIS?

A six-foot chain, carved from one piece of wood. There is not a single join. The work is said to have taken four months.

A Praying Insect

AMONG the many curious insects in this world one of the strangest is the praying mantis. This quaint creature, in some form or other, is to be found in practically all warm countries. Even in Southern Europe the mantis is abundant, and many of the peasant folk regard it with something like reverence. This arises from an old belief that its curious attitude of raising the forelegs shows the mantis to be engaged in prayer. The idea that the insect is sacred is almost world-wide, for in many parts of Asia, Africa, and South America it is considered wrong to kill one.

As a matter of fact, the mantis has acquired a reputation for goodness which it does not in the least deserve. A scientist who has studied the habits of the insect closely tells us that it would be more correct to describe the creature as *preying* rather than praying. The mantis is a voracious feeder, living on flies, grasshoppers, caterpillars, and the like. The capture of its victims is not easy, for the mantis is decidedly slow of movement. The hungry creature relies for the most part on cunning. Its habit is to sit on a twig, or among some leaves, where its colouring of green and brown make it difficult to discover. There it remains, quite still, throwing back the fore part of its long neck-like body, in order to get a view of what is happening on all sides. The big front legs are held up in the well-known praying attitude. At last a likely victim is sighted and, if it be

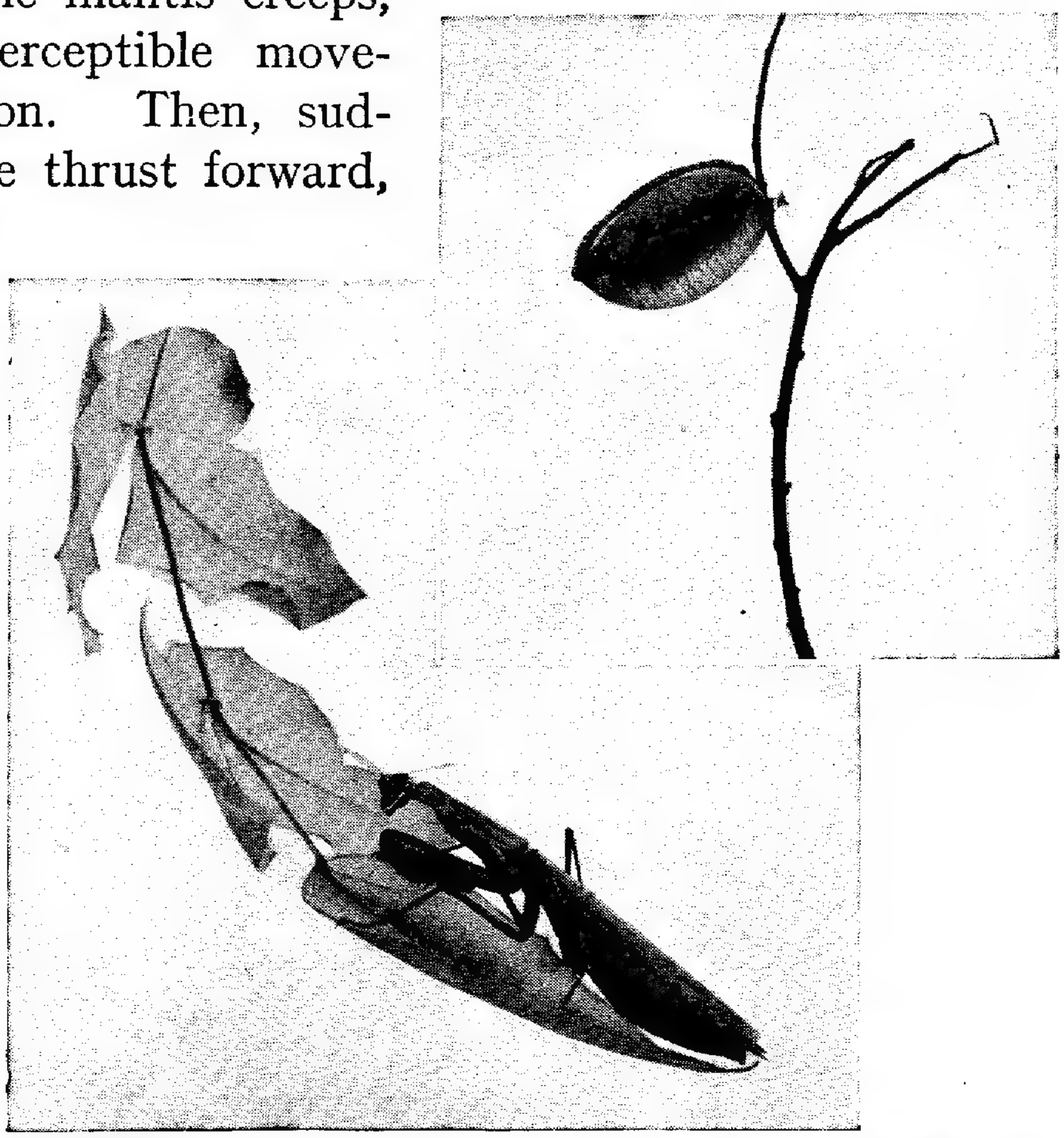


[*Art Photo Agency.*

THE PRAYING MANTIS.

This remarkable insect, of which there are many varieties, is by no means so pious as its name and attitude imply. In fact, it is one of the most crafty and ferocious of creatures. In many parts mantids are kept in cages and matched against each other like fighting cocks.

some distance away, the mantis creeps, with an almost imperceptible movement, in that direction. Then, suddenly, the forelegs are thrust forward, and the prey is grasped in such a way that escape is impossible. Whilst the captive is still struggling, the mantis begins its meal, tearing the body apart with great ferocity.



Photograph by] *[Hugh Main.*

1. A PRAYING MANTIS FROM THE SOUTH OF FRANCE.
2. EGG-CASE.

We could perhaps think more kindly of the mantis if it abandoned its cruel habits when hunger is satisfied, but even when there is plenty of food about the fierce creature seems to take a delight in killing for the sake of killing.

The female mantis is larger and stronger in all ways than the male. As a result, when Mr. Mantis wishes to make love to the lady of his choice he may find himself in an awkward position. Should his advances be acceptable all is well, but should he not be wanted he will be lucky if he escapes alive. Any male mantis that a female dislikes is certain to be killed and eaten unless he quickly slips away. In a general sense the mantids are terrible cannibals, for they make a practice of eating any weakly or injured ones of their own kind.

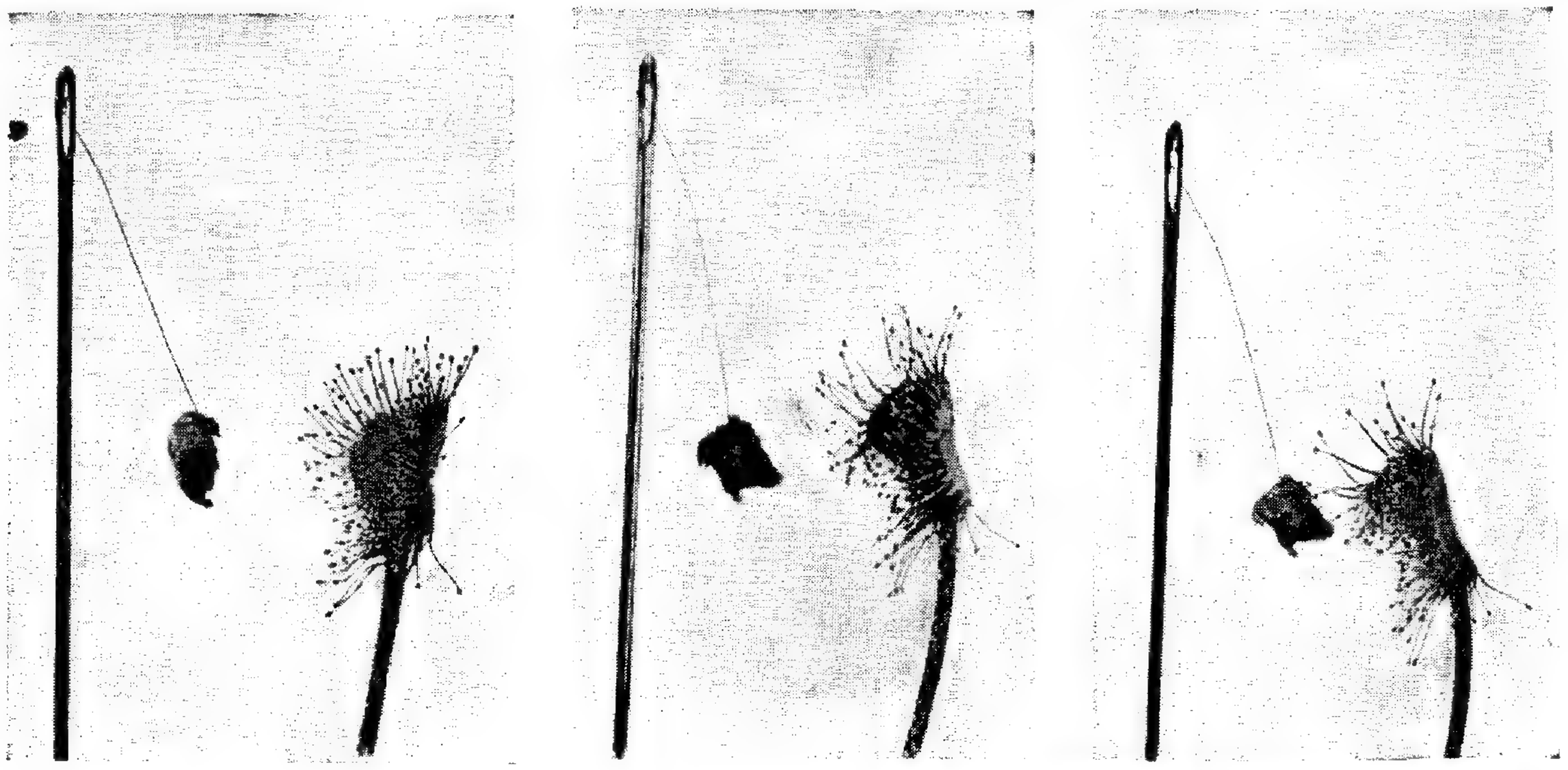
Even the European mantis often closely resembles its surroundings, but some of the species found in the Tropics are perhaps the most wonderful mimics in the world. One kind, found in the East, has wing covers that are marvellous imitations of leaves. Not only are the wings of a bright green colour, but they are veined just like real foliage.

Another kind, found in Siam, is commonly seen sitting among rhododendron blossoms. The insect is very large, and bright pink

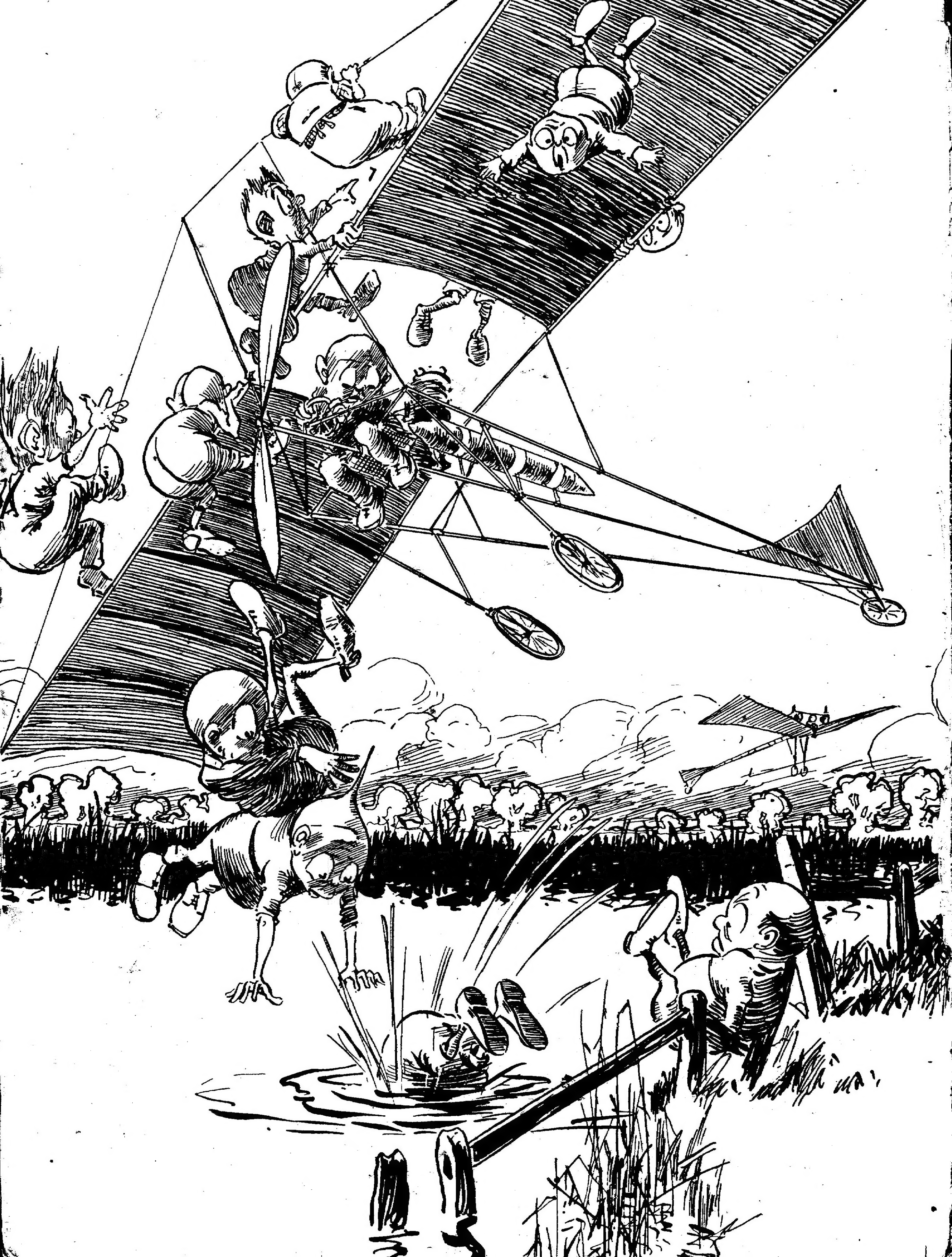
in colour, save for bands of green. So closely does it resemble the flowers among which it is in the habit of settling that, even after the closest scrutiny, it is not detected. Only when the mantis moves is the onlooker aware that a living insect is among the flowers. A curious thing about this mantis is that large numbers of small flies are often found roaming over and around its pink body, evidently believing they are on a real flower. Such tiny winged creatures are too small for the mantis to bother about, but they help in the game of deception. Larger prey, for which the greedy insect is waiting, think when they see little flies unharmed that all must be well, but they soon find their mistake when the forelegs of the mantis suddenly stretch out and seize them.

In parts of China mantids are kept for a curious purpose. Two large females are selected, and placed together in a bamboo cage. A terrific fight ensues, which in a small way provides the brutal excitement of an Old World cock-fight. The victor ends by tearing her opponent in pieces and eating most of the body.

S. LEONARD BASTIN.



(Photographs by Harold Bastin, Reading.

DO PLANTS "KNOW"?

These remarkable photographs seem to prove that the sundew leaf "knows" when food is near. As explained in the article "Plants that Eat Insects," the sundew, found in bogs, is a flesh-eater. A tiny fragment of beef is shown in the first photograph suspended by a hair to a needle. In the second and third photographs the leaf is seen gradually leaning over until the dainty morsel is caught in its sticky hairs.